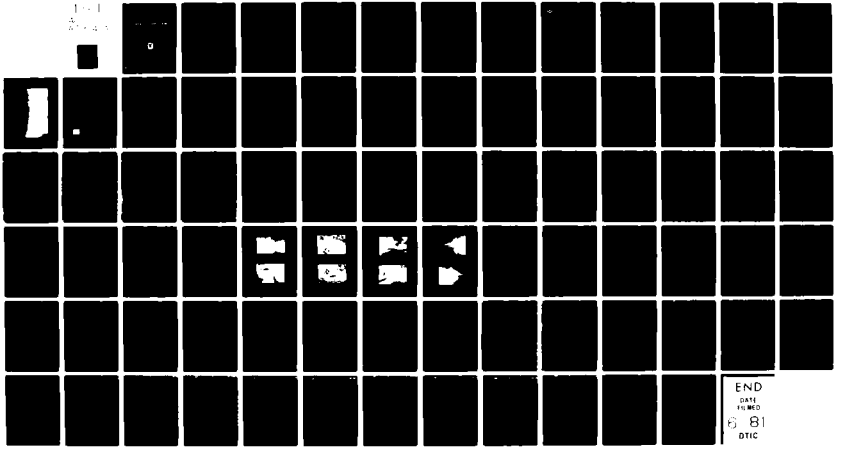
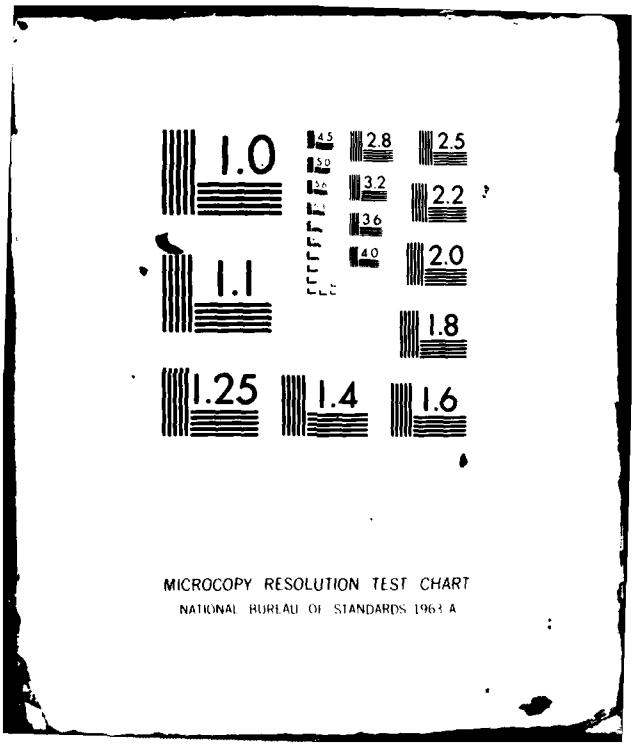
AD-A099 424 NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON --ETC F/G 13/13
NATIONAL DAM SAFETY PROGRAM. LAKE LENAPE DAM (NJ00019). DELAWAR--ETC(U)
MAR 81 P YU DACW61-79-C-0011

UNCLASSIFIED DAEN/NAP-53842/NJ00019-81/ NL



END
DATE FILMED
5 81
DTIC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

AD A099424

DELAWARE RIVER BASIN,
TAR HILL BROOK TRIBUTARY OF
PEQUEST RIVER, SUSSEX COUNTY,
NEW JERSEY.

National Dam Safety Program

LAKE LENAPE DAM
(NJ 00019)

PHASE 1 INSPECTION REPORT.
NATIONAL DAM SAFETY PROGRAM.

Final Rept., Peter Yu, 1984

A

DACW61-79-C-0011

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

Rept. no. DAEN-NAP-53842/NJ00019-81/03

MARCH 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: DAEN/NAP-53842/NJ00019-81/03	2. GOVT ACCESSION NO.: AD A099 424
3. RECIPIENT'S CATALOG NUMBER:	
4. TITLE (and Subtitle): **Phase I Inspection Report National Dam Safety Program** Lake Lenape Dam, NJ00019 Sussex County, NJ	5. TYPE OF REPORT & PERIOD COVERED: FINAL
	6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s): Yu, Peter	8. CONTRACT OR GRANT NUMBER(s): DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Langan Engineering Assoc. Inc. 990 Clifton Ave. Clifton, NJ 07013	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
11. CONTROLLING OFFICE NAME AND ADDRESS: NJ Department of Environmental Protection *Division of Water Resources* P.O. Box CN029 Trenton, NJ 08625	12. REPORT DATE: March, 1981
	13. NUMBER OF PAGES: 55
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office): U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, PA 19106	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Safety Program	Spillways
Embankments	Lake Lenape Dam, NJ	
Visual Inspection	Tar Hill Brook, NJ	
Structural Analysis	Sussec County, NJ	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

21 MAY 1981

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Lenape Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Lenape Dam, a high hazard potential structure, is judged to be in fair overall condition. The spillway is considered seriously inadequate since a flow equivalent to seven percent of the Probable Maximum Flood (PMF) would cause the dam to be overtopped. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard of loss of life downstream from the dam. To ensure adequacy of the structure, the following actions, as a minimum, are recommended.

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within three months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. The following remedial measures should be initiated within six months from the date of approval of this report:

(1) Repair cracks and deteriorated concrete on the retaining wall of the east embankment.

(2) Repair areas of undermining along the footing of the retaining wall of the east embankment.

(3) Remove wood and debris in the downstream channel of the spillway.

(4) Determine the operating condition of the low level outlet, repair if necessary.

c. The following remedial measures should be initiated within one year from the date of approval of this report:

(1) Perform additional investigation to determine the engineering properties of the dam and foundations, whether or not conventional safety margins exist under more severe stress conditions than those observed during our inspection, and what modifications may be required to achieve such safety margins.

(2) Properly remove all trees from the dam embankment and provide adequate filter coverages on the downstream face to prevent any future piping which may occur as a result of possible root decay.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

NAPEN-N

Honorable Brendan T. Byrne

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

LAKE LENAPE DAM (NJ00019)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 27 August and 11 December 1980 by Langan Engineering Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Lenape Dam, a high hazard potential structure, is judged to be in fair overall condition. The spillway is considered seriously inadequate since a flow equivalent to seven percent of the Probable Maximum Flood (PMF) would cause the dam to be overtopped. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard of loss of life downstream from the dam. To ensure adequacy of the structure, the following actions, as a minimum, are recommended.

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within three months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. The following remedial measures should be initiated within six months from the date of approval of this report:

(1) Repair cracks and deteriorated concrete on the retaining wall of the east embankment.

(2) Repair areas of undermining along the footing of the retaining wall of the east embankment.

(3) Remove wood and debris in the downstream channel of the spillway.

(4) Determine the operating condition of the low level outlet, repair if necessary.

c. The following remedial measures should be initiated within one year from the date of approval of this report:

(1) Perform additional investigation to determine the engineering properties of the dam and foundations, whether or not conventional safety margins exist under more severe stress conditions than those observed during our inspection, and what modifications may be required to achieve such safety margins.

(2) Properly remove all trees from the dam embankment and provide adequate filter coverages on the downstream face to prevent any future piping which may occur as a result of possible root decay.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

APPROVED: [signature]

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 1st May 1981

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

2 MAY 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

This is in reference to our ongoing National Program for Inspection of Non-Federal Dams within the State of New Jersey. Lake Lenape Dam (Federal I.D. No. NJ00019), a high hazard potential structure, has recently been inspected. The dam is owned by the Lenape Lake Association, Incorporated, and is located on Tar Hill Brook, a tributary of the Pequest River in Andover, Sussex County.

Using Corps of Engineers screening criteria, it has been determined that the dam's spillway is seriously inadequate because a flow equivalent to seven percent of the Probable Maximum Flood would cause the dam to be overtopped. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise, or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard potential to loss of life downstream from the dam. As a result of this UNSAFE determination, it is recommended that the dam's owners take the following measures within 30 days of the date of this letter:

a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.

b. In the interim, a detailed emergency operation plan and downstream warning system should be promptly developed. Also, around the clock surveillance should be provided during periods of unusually heavy precipitation.

A final report on this Phase I Inspection will be forwarded to you within two months.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies Furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

UNSAFE DAM
NATIONAL PROGRAM OF INSPECTION OF DAMS

a. NAME: Lake Lenape Dam

b. ID NO.: NJ00019

c. LOCATION State: New Jersey, County: Sussex.
River or Stream: Tributary of Pequest River.
Nearest D/S City or Town: Andover.

d. HEIGHT: 27 feet

e. MAXIMUM IMPOUNDMENT CAPACITY: 1096 ac. ft.

f. TYPE: Earthfill.

g. OWNER: Lake Lenape Association.

h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 21 May 1981

i. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT: Preliminary report calculations indicate 7% of the PMF would overtop the dam.

l. URGENCY CATEGORY: High Hazard, UNSAFE, Non-Emergency.

m. EMERGENCY ACTIONS TAKEN:
Gov. notified of this condition by District Engineer's letter of 21 May 1981.

j. DESCRIPTION OF DANGER INVOLVED: High Hazard potential, overtopping and failure of the dam would significantly increase hazard potential to loss of life and property downstream of dam.

n. REMEDIAL ACTIONS TAKEN:
N.J.D.E.P. will notify dam's owner upon receipt of our letter.

k. RECOMMENDATIONS GIVEN TO GOVERNOR:
Within 30 days of the date of the District Engineer's letter the owner should do the following:
a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.
b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, around the clock surveillance should be provided during periods of unusually heavy precipitation.

o. REMARKS: Final report, to be issued within six weeks, will have WHITE cover.

T.B. HEVERIN, Coordinator
Dam Inspection Program
U.S.A.E.D., Philadelphia

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	LAKE LENAPE DAM
ID NUMBER:	FED ID No NJ 00019
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	SUSSEX
STREAM:	TAR HILL BROOK TRIBUTARY OF PEQUEST RIVER
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	AUGUST & DECEMBER 1980

ASSESSMENT OF GENERAL CONDITIONS

Lake Lenape Dam, classified under high hazard potential category, is 53 years old and in fair overall condition. The downstream embankments are thickly covered with trees and brush. The deterioration and start of undermining of the east embankment retaining wall are matters which should be attended to soon. The available design, engineering and construction data are not sufficient to draw a conclusion concerning the actual degree of stability of the dam. Additional investigation is necessary to adequately evaluate the future performance of the dam.

The spillway capacity as determined by the Corps of Engineers Screening Criteria is "seriously inadequate". The dam can adequately pass only 6% of the PMF. The spillway adequacy should be determined using more precise and sophisticated methods and procedures.

The following measures are recommended to be taken very soon:

The spillway of the dam is "seriously inadequate" as defined in the Corps of Engineers ETL 1110-2-234. The need for and type of mitigating measures should be determined, around-the-clock surveillance during periods of unusually heavy precipitation provided and a warning system established.

Rept no. DAEN/NAP-53842/NJ00019-81/03

The following measures are recommended to be taken soon:

Repair cracks and deteriorated concrete on the retaining wall of the east embankment. Repair areas of undermining along the footing of the retaining wall of the east embankment. Remove wood and debris in the downstream channel of the spillway. Determine the operating condition of the low level outlet; repair if necessary. Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

The following measures are recommended to be taken in the near future:

Perform additional investigation to determine the engineering properties of the dam and foundations, whether or not conventional safety margins exist under more severe stress conditions than those observed during our inspection, and what modifications may be required to achieve such safety margins. Properly remove all trees from the dam embankment and provide adequate filter coverages on the downstream face to prevent any future piping which may occur as a result of possible root decay.

K. Peter Yu, P.E.

OVERALL VIEW

LAKE LENAPE DAM

27 August 1980

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	LAKE LENAPE DAM
ID NUMBER:	FED ID No NJ 00019
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	SUSSEX
STREAM:	TAR HILL BROOK TRIBUTARY OF PEQUEST RIVER
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	AUGUST & DECEMBER 1980

LANGAN ENGINEERING ASSOCIATES, INC.

Consulting Civil Engineers
990 CLIFTON AVENUE
CLIFTON, NEW JERSEY
201-472-9366

CONTENTS

NATIONAL DAM SAFETY REPORT

LAKE LENAPE DAM FED ID NO NJ 00019

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SECTION 1 PROJECT INFORMATION

1.1 General

Authority to perform the Phase I Safety Inspection of Lake Lenape Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 12 August 1980. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the US Army Engineers District, Philadelphia.

The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to safety of Lake Lenape Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted. The assessment is made using screening criteria established in Recommended Guidelines for Safety Inspection of Dams prepared by the Department of Army, Office of the Chief of Engineers. It is not the purpose of the inspection report to imply that a dam meeting or failing to meet the screening criteria is, per se, certainly adequate or inadequate.

1.2 Project Description

a. Description of Dam and Appurtances

Lake Lenape Dam is a 440 ft long, 27 ft high earthfill dam with a concrete core wall and concrete notch overfall spillway. The dam has a crest width of approximately 10 ft and side slopes of approximately 2 horizontal to 1 vertical upstream and downstream. The spillway weir is approximately 35 ft long located in about the middle of the dam. The top of the spillway weir is about 3 feet below the crest of the dam. The upstream approach channel is formed by concrete wing walls perpendicular to the spillway weir. The west side of the discharge channel is formed by a concrete and field stone wall perpendicular to the spillway weir for about 10 feet where it abuts a natural rock outcrop at an angle of about 45°. The east side of the discharge channel is formed by a vertical concrete retaining wall perpendicular to the spillway weir for about 14 feet where it turns approximately 45° counter-clockwise twice to support the downstream embankment. A 20 inch-diameter cast iron low level outlet pipe runs through the east embankment and discharges through the retaining wall at streambed level. The control valve is located on the upstream end of the pipe.

b. Location

Lake Lenape Dam is located at the south west end of Lake Lenape off Lake Lenape Road, Andover Township, Sussex County, New Jersey. It is at north latitude 41°00.0' and west longitude 74° 44.0'. A regional vicinity map is given in Fig. 1.

c. Size Classification

Lake Lenape Dam is classified as being "Intermediate" on the basis of its maximum reservoir storage volume of 1096 acre feet which is more than 1,000 acre feet, but less than 50,000 acre feet. It is classified as "Small" on the basis of its maximum height of 27 feet, which is less than 40 feet. Accordingly, the dam is classified as "Intermediate" in size.

d. Hazard Classification

In the National Inventory of Dams, Lake Lenape Dam has been classified as having "High Hazard Potential" on the basis that failure of the dam would cause excessive property damage to residences downstream, and could potentially cause more than a few deaths. Visual inspection shows that a house is located on top of the east embankment and a number of private homes are located in downstream low lying areas; all of which would be seriously affectd in the event of a failure of the dam. Accordingly, it is proposed to keep the Hazard Classification Potential as "High".

e. Ownership

Lake Lenape Dam is owned by the Lake Lenape Association Inc., P. O. Box 438, Andover, New Jersey, as reported by the Andover Township Tax Assessor's Office.

f. Purpose of Dam

The purpose of the dam is recreational.

g. Design and Construction History

Snook and Hardin Engineers of Newton, New Jersey prepared the plans and specifications and supervised construction of the dam.

h. Normal Operational Procedures

No information is available concerning operational procedures for the dam.

1.3 Pertinent Data

a. Drainage Areas	5.16 sq mi estimated from USGS Topo Revised 1971
b. Discharge at Damsite	
Maximum flood at damsite	Unknown
Ungated spillway capacity at maximum pool elevation	739 cfs (Assumed to be top of dam)
Total spillway capacity at maximum pool elevation	739 cfs (Assumed to be top of dam)

c. Elevation (Elevations taken from original drawings of dam, datum unknown)

Top Dam	109.1
Maximum pool-design surcharge	Unknown
Recreation pool	105.6 (Assumed to be top of spillway)
Spillway crest	105.6
Streambed at centerline of dam	El 82
Maximum tailwater	Unknown, dry at time of inspection

d. Reservoir

Length of maximum pool	Approx 3800 ft
Length of recreation pool	Approx 3750 ft

e. Storage (acre-feet)

Recreation pool	939 ac ft
Design surcharge	Unknown
Top of dam	1096 ac ft

f. Reservoir Surface (acres)

Top dam	45.43
Maximum pool	45.43 (Assume top of dam)
Recreation pool	44.08 acres (Assumed to be spillway crest)
Spillway crest	44.08 acres

g.	Dam	
	Type	Earthfill embankment
	Length	440 ft
	Height	27 ft max.
	Top Width	10 ft
	Side Slopes	2H:1V Upstream & downstream
	Zoning	Unknown
	Impervious Core	Concrete core wall
	Cutoff	Reported to be concrete core wall to bedrock or hardpan
h.	Spillway	
	Type	Concrete over-fall
	Length of weir	35 ft
	Crest elevation	105.6 (Datum unknown)
	Gates	None
	U/S Channel	Concrete wing walls perpendicular to spillway
	D/S Channel	1:1 sloped concrete pad & natural Rock
i.	Regulating Outlets	1-20 in dia cast iron pipe low level outlet thru east embankment with valve, operating condition unknown.

NOTE: Elevations were taken from the original design drawings by Snook & Hardin 1926, datum unknown.

SECTION 2 ENGINEERING DATA

2.1 Design

Plans and Specifications prepared in 1926 by Snook and Hardin Engineers are on file with the New Jersey Department of Environmental Protection, Dam Application No. 80. No information is available concerning the engineering properties of materials used in dam construction or the underlying foundation materials. Plans and specifications indicate the concrete core wall had been founded on bedrock or extended 1 foot into hardpan whichever occurred first.

2.2 Construction

Very little information is available concerning the construction of the dam. Reports on Dam Inspection were submitted by Mr. John N. Brooks, Hydraulic Engineer for the New Jersey State Water Commission for the dates 15 June, 3 September, 28 September, 28 October 1926 and 15 April 1927. The dam was accepted by the State of New Jersey Water Policy Commission 1 June, 1931.

2.3 Operation

Operation of the dam is by the Lake Lenape Association, Inc. There are no formal operating procedures available.

2.4 Evaluation

Available information is inadequate to evaluate the design, construction and operation of Lake Lenape Dam.

SECTION 3 VISUAL INSPECTION

Site inspection disclosed the earthfill dam embankment to be in fair condition. Much of the original downstream embankment is no longer visible due to the placement of additional fill for house construction and fields. The embankments, particularly the downstream slope, are thickly covered with trees and brush. Riprap along the upstream face appears evenly placed.

The spillway appears to be founded on rock. In the center of the spillway is a concrete pier which appears to have supported a bridge over the spillway. The bridge no longer exists. The approach channel was free of debris and obstructions at the time of inspection. The concrete forming the downstream wing walls has minor spalling on the west wall and has large cracks and spalling on the east wall. Portions of the footing of the east retaining wall is becoming slightly undermined by the spillway discharge. The concrete weir has areas of minor spalling. The bottom of the downstream channel is formed by a jagged rock outcrop. Fallen tree limbs and other debris have become lodged in the rock.

The control valve for the cast iron low level outlet is located below pool level and its operating condition is unknown.

The reservoir area is surrounded by residential homes. The shore line is comprised of lawns, treed areas and rock outcrop.

Some fallen branches exist in the discharge channel downstream of the spillway. The stream bed is lined with boulders. The channel immediatley downstream of the spillway is relatively narrow and steep with a slope of about 1H:1V for a distance of about 60 ft.

SECTION 4 OPERATIONAL PROCEDURES

No information is available concerning operational procedures for Lake Lenape Dam. Maintenance of the dam and low level outlet is by the Lake Lenape Association, Inc.

There was no warning system apparent during our inspection.

SECTION 5 HYDRAULIC/HYDROLOGIC

The hydraulic/hydrologic evaluation is based on a Spillway Design Flood (SDF) equal to the Probable Maximum Flood chosen in accordance with the evaluation guidelines for dams classified as high hazard and intermediate in size. No hydrologic design data for this dam was available.

Conversations with local residents indicate no overtopping has occurred in at least the last 20 years.

The PMF has been determined by developing a synthetic hydrograph based on the probable maximum precipitation of 22.2 inches (200 sq. mi. - 24 hour). The Corps of Engineers has recommended the use of the SCS triangular unit hydrograph with the curvilinear transformation. Hydrologic computations are presented in Appendix 3. The PMF peak inflow determined for the subject watershed is 13,843 cfs.

The capacity of the spillway at maximum pool elevation 109.1 is 739 cfs which is significantly less than the SDF. Flood routing for the 1/2 PMF and PMF indicates the dam will overtop by 2.89 ft & 4.94 ft respectively. We estimate the dam can adequately pass only 6% of the PMF. Based on our knowledge of the dam as an earthfill embankment and our knowledge of the degree of overtopping potential, it is our opinion that overtopping by the 1/2 PMF would likely cause failure.

A potential damage center exists immediately downstream of the dam. A single family house exists on top of the east embankment and at least 3 houses are located at low enough elevations to be seriously affected in the event of an extraordinary high discharge from the dam. Due to the fact that the

discharge channel in this area is narrow and steep, the other houses at higher elevations adjacent to the channel would likely be affected in the event of overtopping failure.

Based on the above observations we conclude that dam failure from overtopping would significantly increase the hazard potential for excessive economic loss or loss of life downstream from the dam from that which would exist just before overtopping failure. Therefore the spillway capacity of Lake Lenape Dam is considered to be "seriously inadequate" as defined in the Corps of Engineers ETL 1110-2-234.

The present drawdown structure consists of a 20-inch cast iron pipe and valve. Its operating condition is unknown.

Drawdown of the reservoir has been evaluated assuming that the drawdown structure is operable. Our calculations indicate that the lake level could be lowered 5 1/2 ft in approximately 5 days and 11 1/2 ft in approximately 12 days.

SECTION 6 STRUCTURAL STABILITY

Based on visual observations, no immediate instability appears to exist in Lake Lenape Dam under normal conditions. Our visual examination of the dam reveals that additional fill has been placed along much of the downstream face of the dam. The spillway section appears to be found on rock. Portions of the footing of the east downstream retaining wall is becoming slightly undermined by the spillway discharge.

No information is available concerning the engineering properties of the foundation and dam materials. Consequently, analysis of the degree of stability of the dam cannot be made without gross assumptions concerning these properties.

There are no operating procedures or records for Lake Lenape Dam.

Lake Lenape Dam is located in Seismic Zone 1 of the Seismic Zone Map of Contiguous States. As no information is available concerning the engineering properties of the foundation and dam materials, the degree of stability of the dam and appurtenances under more severe stress conditions than normal and its future performance cannot be evaluated without further investigation.

SECTION 7 ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

Lake Lenape Dam is 53 years old and in fair overall condition. The downstream embankments are thickly covered with trees and brush. The deterioration and start of undermining of the east embankment retaining wall are matters which should be attended to soon. The available design, engineering

and construction data are not sufficient to draw a conclusion concerning the actual degree of stability of the dam. Additional investigation is necessary to adequately evaluate the future performance of the dam.

The spillway capacity as determined by the Corps of Engineers Screening Criteria is "seriously inadequate". The dam can adequately pass only 6% of the PMF. The spillway adequacy should be determined using more precise and sophisticated methods and procedures.

7.2 Recommendations/Remedial Measures

The following measures are recommended to be taken very soon:

1. The spillway of the dam is "seriously inadequate" as defined in the Corps of Engineers ETL 1110-2-234. The need for and type of mitigating measures should be determined, around-the-clock surveillance during periods of unusually heavy precipitation provided and a warning system established.

The following measures are recommended to be taken soon:

1. Repair cracks and deteriorated concrete on the retaining wall of the east embankment.

2. Repair areas of undermining along the footing of the retaining wall of the east embankment.

3. Remove wood and debris in the downstream channel of the spillway.

4. Determine the operating condition of the low level outlet; repair if necessary.

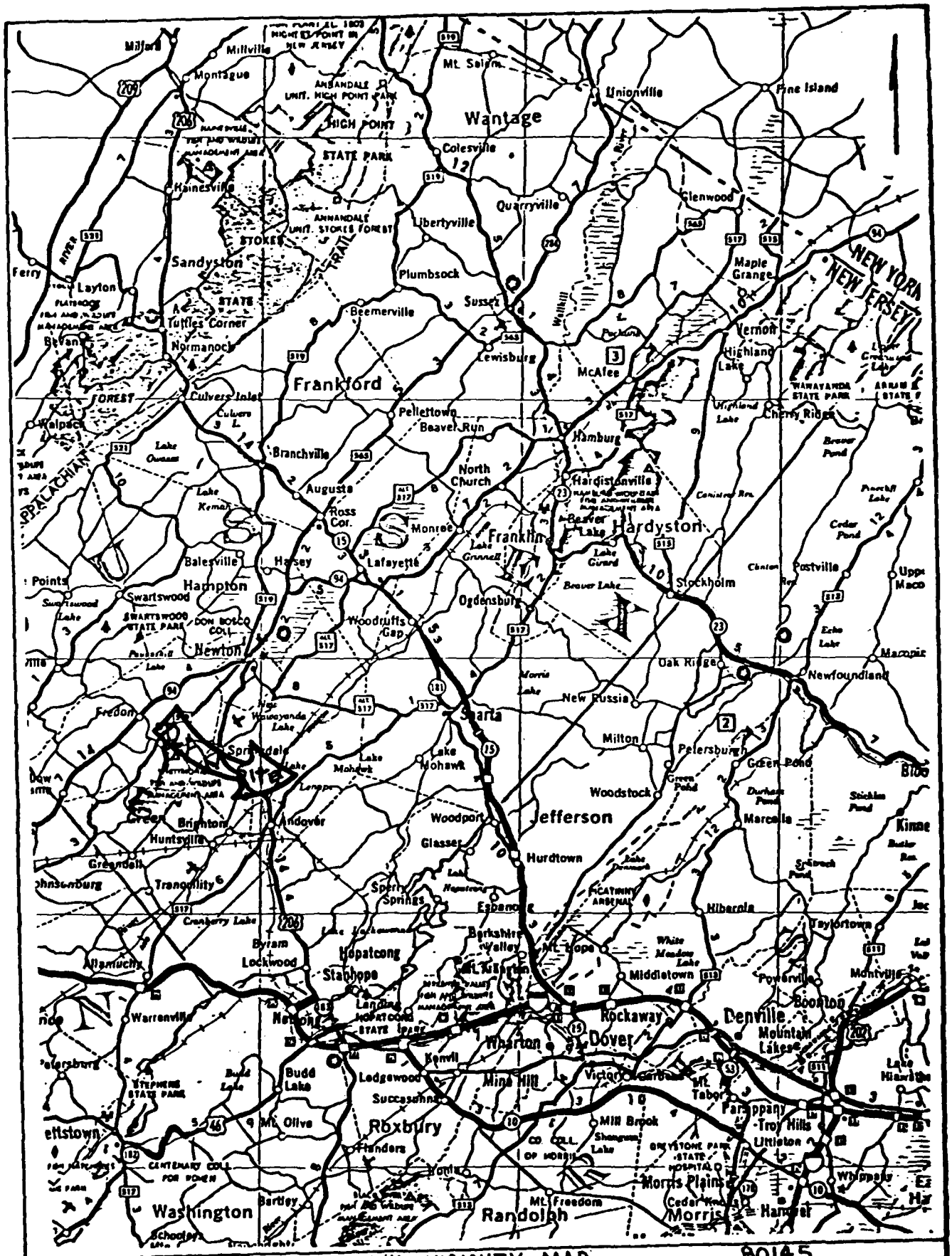
5. Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

The following measures are recommended to be taken in the near future:

1. Perform additional investigation to determine the engineering properties of the dam and foundations, whether or not conventional safety margins exist under more severe stress conditions than those observed during our inspection, and what modifications may be required to achieve such safety margins.

2. Properly remove all trees from the dam embankment and provide adequate filter coverages on the downstream face to prevent any future piping which may occur as a result of possible root decay.

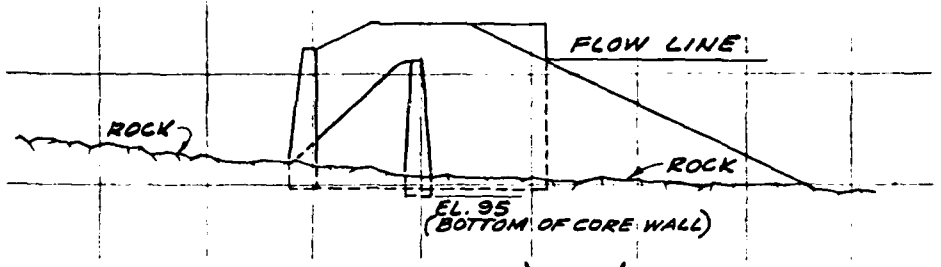
FIGURES



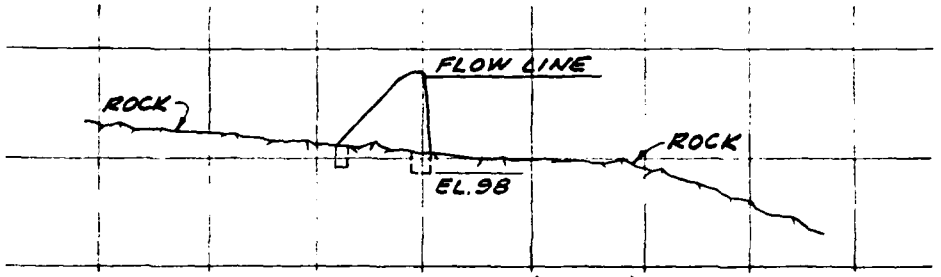
BY _____ DATE _____ REGIONAL VICINITY MAP JOB NO. 80145

CKD _____ DATE _____ LAKE LENAPE FIGURE 1

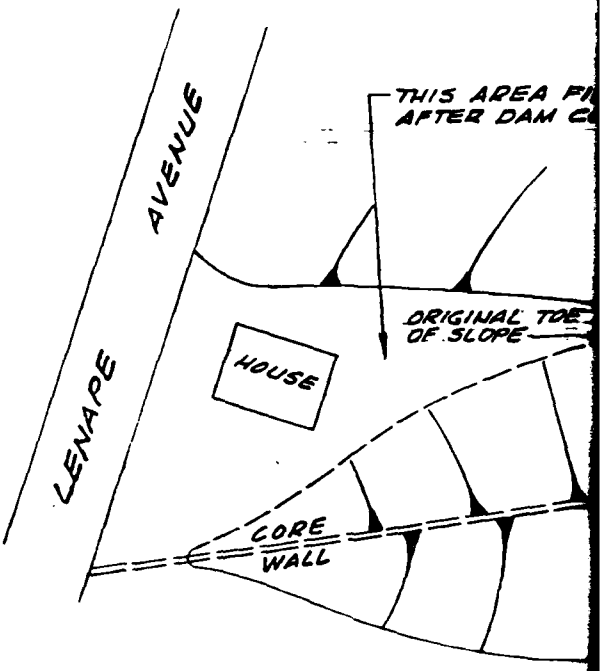
Scale: 1 in = 2 miles



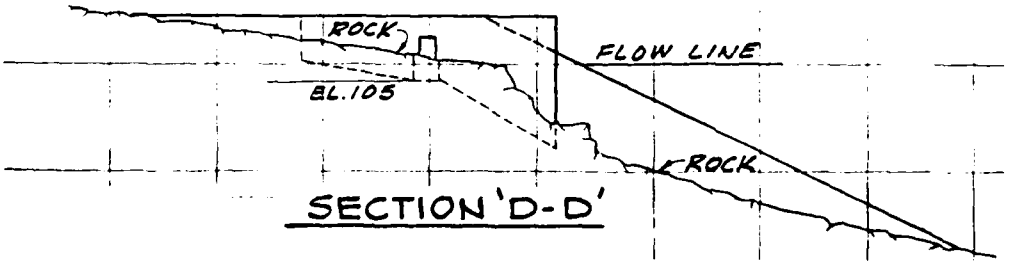
SECTION 'B-B'



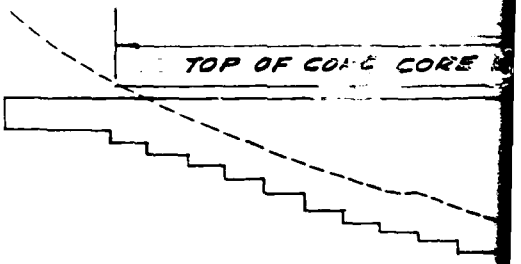
SECTION 'C-C'

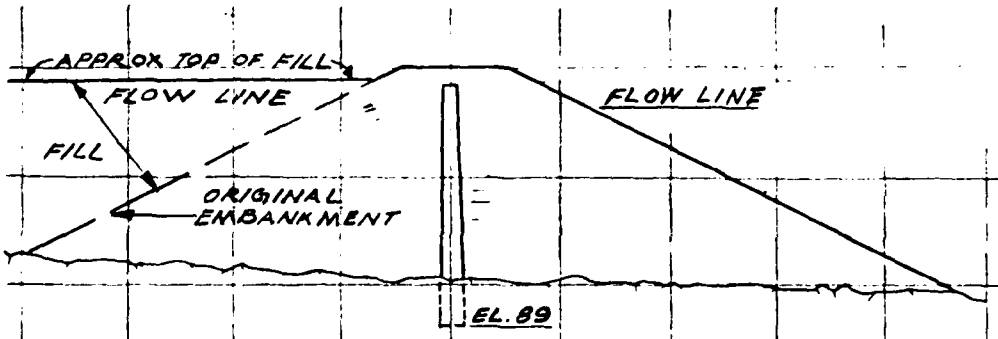


FOR DETA
SPILLWAY
SEE FIGU

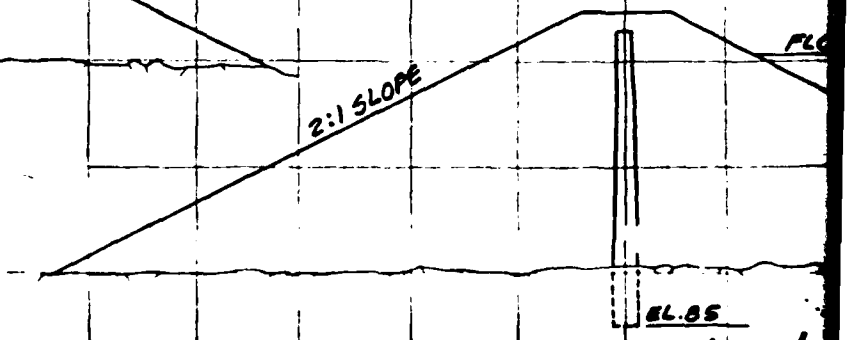


SECTION 'D-D'

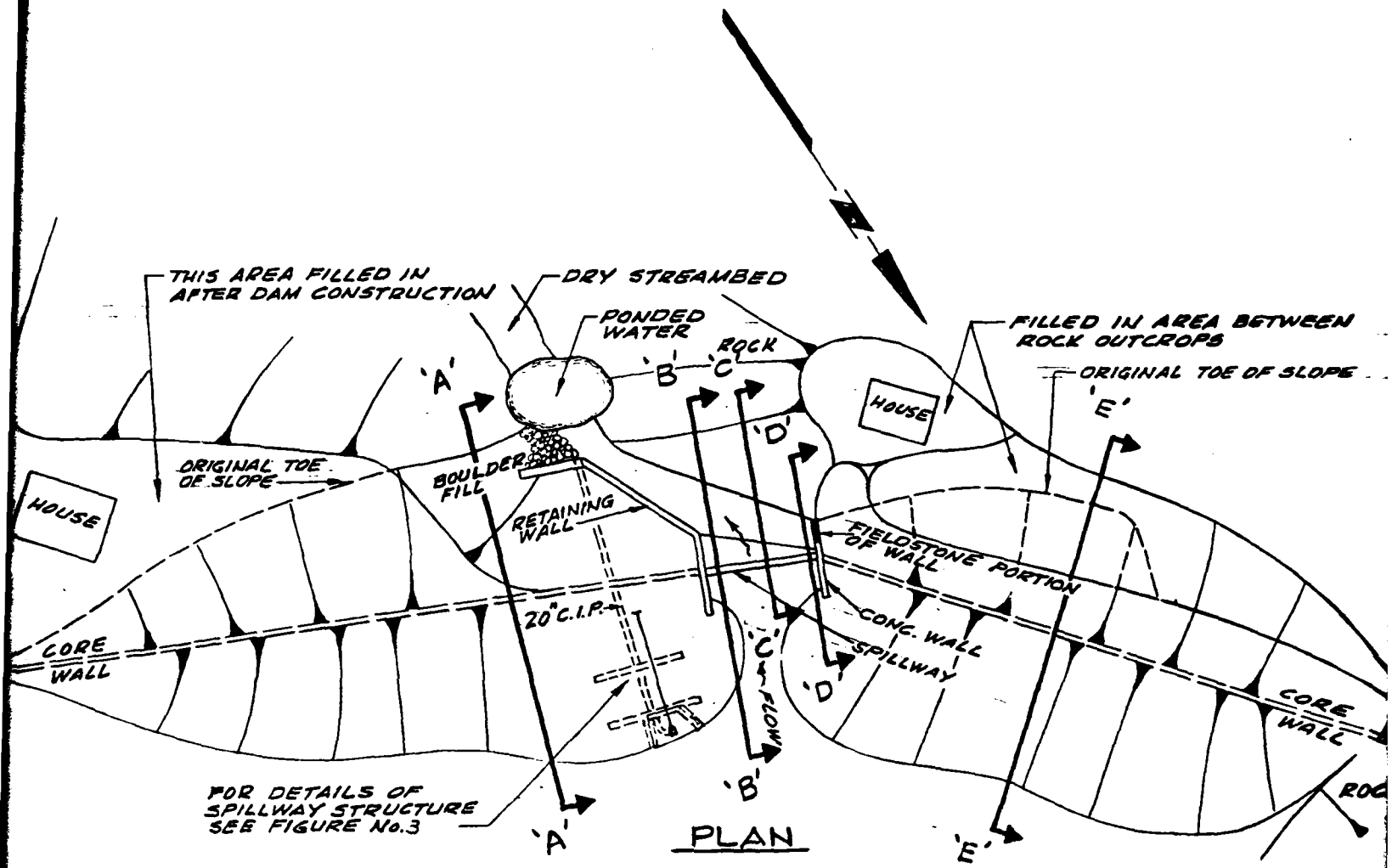




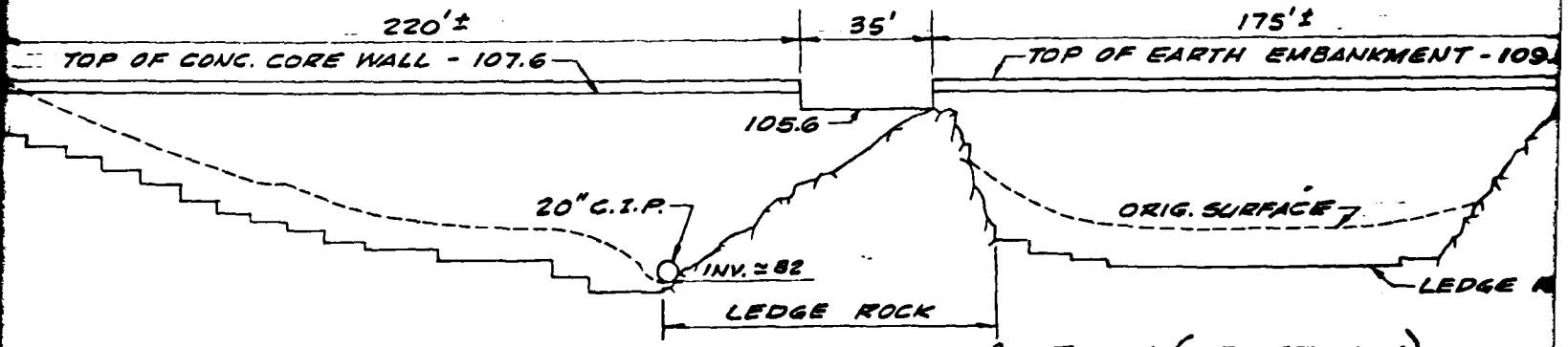
SECTION 'E-E'



SECTION 'A-A'



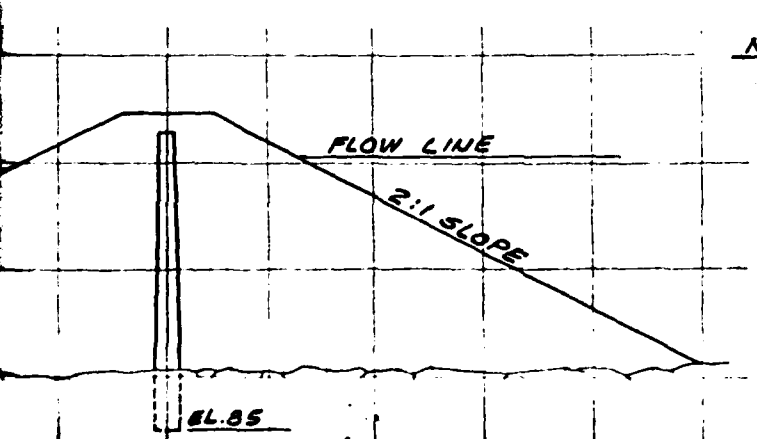
PLAN



CROSS SECTION (UPSTREAM)

NOTES: 1. DATA TAKEN FROM DRWG. ENTITLED "PLAN-PR & CROSS SECTIONS - LAKE LENAPE" PREPARED LENAPE CORP. INC. BY SNOOK & HARDIN, ENGIN NEWTON, N.J., MAY, 1926.

2. ELEVATIONS TAKEN FROM ORIGINAL DRAWINGS - DA UNKNOWN.



SECTION 'A-A'

GENERAL PLAN & SECTIONS

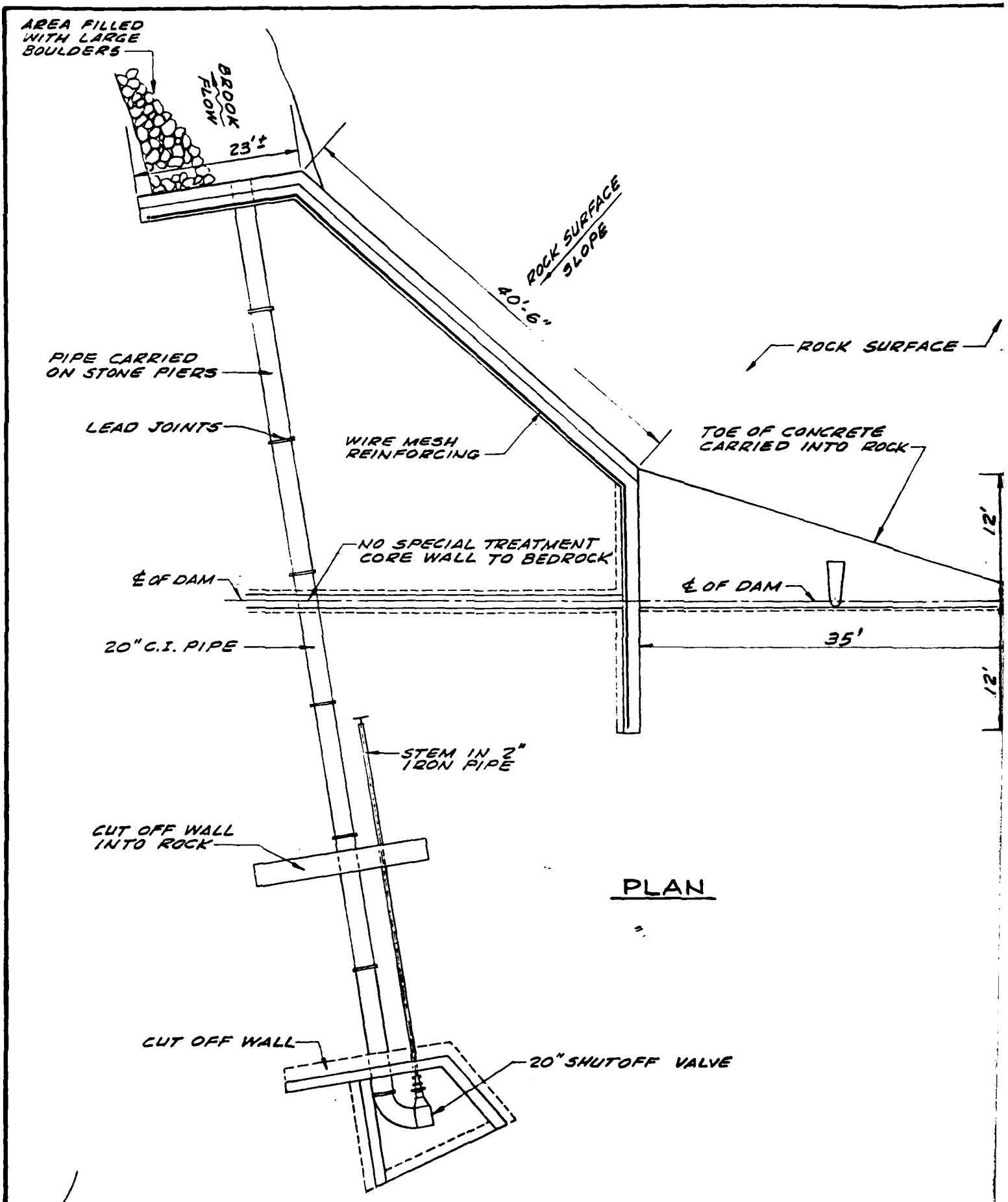
LAKE LENAPE DAM

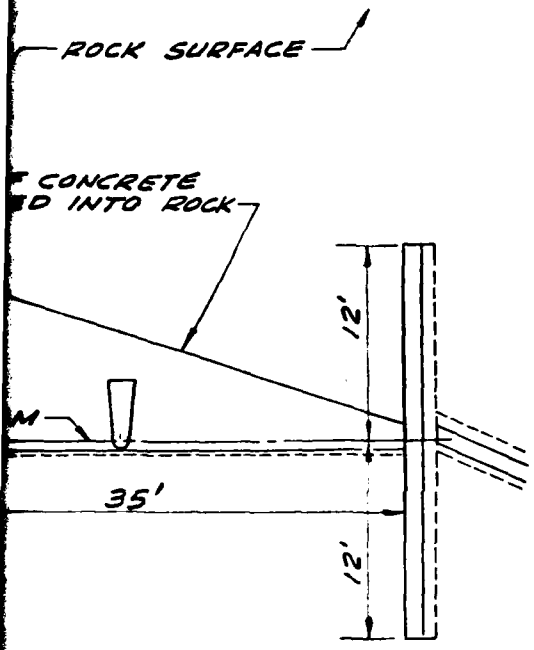
ANDOVER TOWNSHIP, SUSSEX COUNTY, N

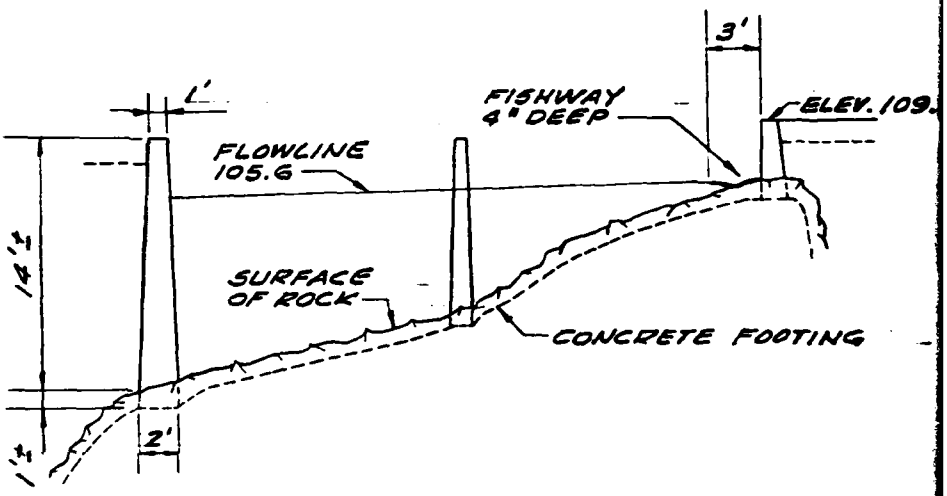
LANGAN ENGINEERING ASSOCIATES, INC.

990 CLIFTON AVENUE CLIFTON, N.J. 07013

DRN. BY: R.D.	SCALE: N.T.S.	JOB No. 8014
CK'D. BY: V.U.	DATE: 9-4-80	FIG. No. 2


AREA FILLED WITH LARGE BOULDERS
BROOK FLOW
23'±
ROCK SURFACE SLOPE
40'-6"
ROCK SURFACE
PIPE CARRIED ON STONE PIERS
LEAD JOINTS
WIRE MESH REINFORCING
TOE OF CONCRETE CARRIED INTO ROCK
12'
NO SPECIAL TREATMENT CORE WALL TO BEDROCK
℄ OF DAM
℄ OF DAM
20" C.I. PIPE
35'
12'
STEM IN 2" IRON PIPE
CUT OFF WALL INTO ROCK
PLAN
CUT OFF WALL
20" SHUTOFF VALVE





SECTION THRU SPILLWAY

NOTES:

1. DATA TAKEN FROM DRWG. ENTITLED "PLAN - PROFIL & CROSS SECTIONS - LAKE LENAPE" PREPARED FO LENAPE CORP., INC. BY SNOOK & HARDIN, ENGINEER NEWTON, N.J., MAY, 1926.
2. ELEVATIONS TAKEN FROM ORIGINAL DRAWINGS - DATUM UNKNOWN.

PLAN & SECTION - SPILLWAY STRUCTU
LAKE LENAPE DAM
ANDOVER TOWNSHIP, SUSSEX COUNTY, N.

LANGAN ENGINEERING ASSOCIATES, INC.
990 CLIFTON AVENUE CLIFTON, N.J. 07013

DRN. BY: R.D.	SCALE: N.T.S.	JOB No. 8014
CK'D. BY: V.A.U	DATE: 9-4-80	FIG. No. 3

APPENDIX 1

ENGINEERING DATA

LAKE LENAPE DAM

1. HYDROLOGIC AND HYDRAULIC DATA CHECK LIST
2. VISUAL EXAMINATION CHECK LIST
3. ENGINEERING DATA CHECK LIST

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.16 sq. mi., wood or forest land.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 105.6 (939 ac ft)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 109.1 (1096 ac ft)

ELEVATION MAXIMUM DESIGN POOL: 107.6 (According to original Design Calc.)

ELEVATION TOP DAM: 109.1

CREST: Spillway

a. Elevation 105.6
b. Type Over-fall
c. Width Approx 1.5 ft
d. Length 35 ft
e. Location Spillover approx middle of dam
f. Number and Type of Gates none

OUTLET WORKS:

a. Type 20" cast iron pope & shutoff valve
b. Location approx 20 ft from spillway
c. Entrance inverts 82±
d. Exit inverts 82 ±
e. Emergency draindown facilities none observed

HYDROMETEOROLOGICAL GAGES: none observed
a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 739 cfs (@ el 109.1 top of dam)

Note: Elevations taken from original drawings of dam.
Reference datum unknown.

Check List
Visual Inspection
Phase 1

Name Dam LAKE LENAPE DAM County SUSSEX State NJ Coordinators NJ DEP

Date(s) Inspection 8/27/80 Weather CLEAR Temperature MID 80's F

Pool Elevation at Time of Inspection 105.0 M.S.L. Tailwater at Time of Inspection DRY M.S.L.

DATUM UNKNOWN, ELEVATION REFERENCED TO ORIGINAL DRAWING OF DAM.

Inspection Personnel:

RICHARD W. GREENE 8/27/80

DENNIS J. LEARY 12/11/80

K. PETER YU 12/11/80

RICHARD W. GREENE Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE VISIBLE	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE VISIBLE	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	NONE VISIBLE	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	NO MOVEMENT APPARENT	
RIPRAP FAILURES	RIPRAP LOOKS EVENLY PLACED UPSTREAM NO RIPRAP VISIBLE DOWNSTREAM	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
EMBANKMENT EAST & WEST OF SPILLWAY	HEAVILY VEGETATED WITH TREES & BRUSH.	REMOVE ALL TREES AND BRUSH
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	ALL JUNCTIONS APPEAR SATISFACTORY.	
ANY NOTICEABLE SEEPAGE	NONE OBSERVED.	
STAFF GAGE AND RECORDER	NONE OBSERVED	
DRAINS	NONE OBSERVED.	

OUTLET WORKS 20 IN ϕ CI LOW LEVEL OUTLET PIPE

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	NOT APPLICABLE - OUTLET IS CAST IRON PIPE.	
INTAKE STRUCTURE	BELOW POOL LEVEL IN UPSTREAM EAST EMBANKMENT.	NOT VISIBLE.
OUTLET STRUCTURE	20" DIA CAST IRON PIPE LEVEL OUTLET WITH VALVE.	
OUTLET CHANNEL	DISCHARGES INTO DOWNSTREAM STREAMBED.	
EMERGENCY GATE	NONE OBSERVED.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	MINOR SPALLING OF CONCRETE.	REPAIR DETERIORATED CONCRETE.
APPROACH CHANNEL	CONCRETE WING WALLS PERPENDICULAR TO SPILLWAY UPSTREAM. MINOR SPALLING OF CONCRETE. NO DEBRIS IN APPROACH CHANNEL.	REPAIR DETERIORATED CONCRETE.
DISCHARGE CHANNEL	EAST SIDE - VERTICAL CONCRETE WING WALL BOTTOM AND WEST SIDE FORMED BY NATURAL ROCK OUTCROP SURFACE. SMALL DIAMETER BRANCHES ARE LODGED IN THE CHANNEL. VERY UNEVEN, JAGGED SURFACE OF THE CHANNEL BOTTOM FORMED BY THE ROCK. CONCRETE OF EAST WALL HAS LARGE CRACKS & SPALLING SURFACE AROUND CRACKS & JOINTS.	REMOVE CHANNEL OBSTRUCTION. REPAIR DETERIORATED CONCRETE.
BRIDGE AND PIERS	ONE PIER IN THE CENTER OF THE SPILLWAY. IT NO LONGER SUPPORTS ANYTHING.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	WEST SHORE MAINLY ROCK OUTCROP APPROX SLOPE 2H:1V EAST SHORE OVERBURDEN MAINLY SLOPE APPROX 4H:1V	
SEDIMENTATION	VERY LITTLE OBSERVED	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	STEEP 1:1 IMMEDIATELY BELOW SPILLWAY TO APPROX EL 82 RAPIDLY DROPPING STREAM CHANNEL WHICH IS LINED WITH BOULDERS. SOME FALLEN BRANCHES EXIST IN CHANNEL.	REMOVE FALLEN BRANCHES.
SLOPES	STEEP, VARIABLE SIDE SLOPES WITH ROCK OUTCROPS.	
APPROXIMATE NO. OF HOMES AND POPULATION	APPROX. 6 PRIVATE SINGLE FAMILY HOMES IMMEDIATELY DOWNSTREAM. AT LEAST 3 OF THEM ARE LOCATED AT RELATIVELY LOW ELEVATIONS. SERIES OF STRUCTURES ABOUT 3000 FT DOWNSTREAM.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS		
PLAN OF DAM	PLAN, PROFILE & CROSS SECTIONS LAKE LENAPE ANDOVER TOWNSHIP - SUSSEX CO., N.J. FOR THE LENAPE CORP., INC.	Prepared By: SNOOK AND HARDIN ENGR's NEWTON, N. J. May, 1926	Source: NJ DEP APPLICATION #80
REGIONAL VICINITY MAP	SEE FIG. 1		
CONSTRUCTION HISTORY SOURCE: NJ DEP APPLICATION #80	MONTHLY PROGRESS REPORTS BY SNOOK & HARDIN, PRINCIPLE ENGINEERS, FOR JUNE, JULY, AUGUST, SEPT., OCT., NOV., DEC., 1926 DAM INSPECTIONS BY JOHN N. BROOKS, HYDRAULIC ENGINEER, TRENTON, NJ, FOR JUNE 1 & 15, SEPT. 28, OCT. 28, 1926 DAM INSPECTION BY H. T. CRITCHLOW, CHIEF, DIV. OF WATERS, TRENTON, N. J. SEPT. 3, 1926.		
TYPICAL SECTIONS OF DAM	PLAN PROFILE & CROSS SECTIONS LAKE LENAPE ANDOVER TOWNSHIP - SUSSEX CO., N.J. FOR THE LENAPE CORP., INC.	Prepared By: Snook and Hardin Engr's Newton, N. J. May 1926	Source: NJ DEP APPLICATION #80
HYDROLOGIC/HYDRAULIC DATA			
OUTLETS - PLAN	20" ϕ CI PIPE SHOW ON - DETAILS PROPOSED DAM, LAKE LENAPE, ANDOVER TOWNSHIP, SUSSEX CO., NJ PREPARED BY: SNOOK AND HARDIN ENGR"S, NEWTON, NJ; FOR THE LENAPE CORP., INC. SHEET @		
- DETAILS	SAME		
-CONSTRAINTS	NONE	SOURCE: N.J. DEP APPLICATION #80	
-DISCHARGE RATINGS	NONE		
RAINFALL/RESERVOIR RECORDS	NONE FOUND		

ITEM	REMARKS
DESIGN REPORTS	NONE FOUND
GEOLOGY REPORTS	NONE FOUND
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	NONE FOUND
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	NONE FOUND
POST-CONSTRUCTION SURVEYS OF DAM	REPORT ON DAM INSPECTION LAKE LENAPE DAM DAM APPLICATION NO. 80 BY JAMES C. RILEY, PRINCIPLE ENGINEER, HYDRAULIC DATE: oct. 11, 1961
BORROW SOURCES.	

SOURCE: NJ DEP
APPLICATION #80

ITEM	REMARKS
MONITORING SYSTEMS	NONE
MODIFICATIONS	HOUSES AND FIELDS BUILT ON DOWNSTREAM EMBANKMENTS ON EAST AND WEST SIDES ON FILLED AREAS
HIGH POOL RECORDS	NONE FOUND
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE FOUND
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE REPORTED
MAINTENANCE OPERATION RECORDS	NONE FOUND

ITEM	REMARKS	
SPILLWAY PLAN	DETAILS PROPOSED DAM LAKE LENAPE	Prepared By: SNOOK AND HARDIN ENGR'S
SECTIONS	ANDOVER TOWNSHIP, SUSSEX CO. - NJ	NEWTON NJ
	FOR THE LENAPE CORP., INC.	SOURCE: NJ DEP
DETAILS		APPLICATION No. 80
OPERATING EQUIPMENT PLANS & DETAILS	VALVE FOR 20" ϕ LOW LEVEL OUTLET LOCATION SHOWN ON DETAILS, PROPOSED DAM LAKE LENAPE ANDOVER TOWNSHIP, SUSSEX CO., N.J. FOR THE LENAPE CORP., INC. BY SNOOK & HARDIN ENGR'S NEWTON, NJ MAY, 1926	
	DETAILS AS TO MAKE & MODEL NOT GIVEN IN PLANS OR SPECIFICATIONS	

APPENDIX 2
PHOTOGRAPHS

Upstream Face of Dam 27 August 1980

East side of spillway showing approach channel wall and crest 27 August 1980

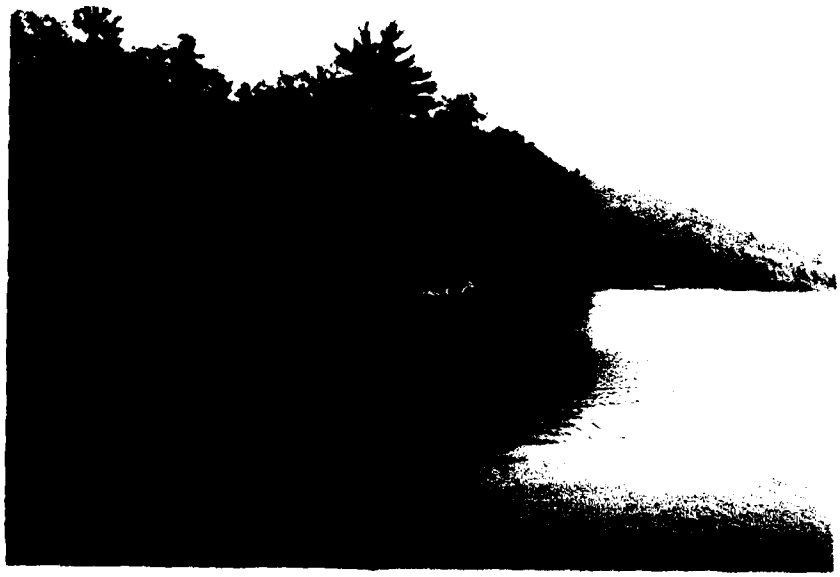
West side of spillway showing approach channel wall and crest. 27 August 1980

Discharge channel formed by retaining wall on east side and rock outcrop on west side, looking downstream. 27 August 1980

East embankment crest looking west from east abutment of dam. 27 August 1980

West embankment crest, looking west from west side of spillway. 27 August 1980

View of east reservoir shoreline taken from spillway. 27 August 1980



View of west reservoir shoreline taken from spillway 27 August 1980

APPENDIX 3
HYDROLOGIC COMPUTATIONS

LANGAN ENGINEERING ASSOCIATES, INC.

HYDROLOGICAL COMPUTATIONS

LAKE LENAPE DAM

A. Location: Sussex County, N.J., Tar Hill Brook (trib. of Pequest River)

B. Drainage area: 5.16 sq. mi (3302 acres)

C. Lake area: 44.08 acres

D. Classification: Size – INTERMIDIATE
Hazard – high

E. Spillway Design Flood: PMF

F. PMP:

1. Dam located in ~~Zone~~ 6 (near ~~Zone~~ 1 boundary)
PMP = 22. inches (for 200 sq mi, 24 hr "allseason envelope") *

2. PMF must be adjusted by a factor of 0.80 ** to account for the basin size of less than 10 sq. mi.

% Factor for ≤ 10 sq. mi			
Duration	~~Zone~~ 1	~~Zone~~ 6	Avg
0-6	111	113	112
0-12	123	123	123
0-24	133	132	132
0-48	142	142	142

* HMR #33

** from pg 48 "Design of Small Dams"

BY VAK DATE 9-17-80 Lake Lenape Dam JOB NO. 80145

CKD PG DATE 3/3/81 SHEET NO. 1 OF

LANGAN ENGINEERING ASSOCIATES, INC.

G. UNIT HYDROGRAPH

Corps of Engineers has indicated that the SCS triangular unit hydrograph with curvilinear transformation be used for analysis

Drainage area = 3302 ac (a)

average slope = 2.2 % (Y)

1) hydraulic length (L)

from drainage map

$l = 18{,}000$ ft

Soil group C, * wood or forest land CN = 74**

$$S = \frac{1000}{CN} - 10 = 3.51$$

Lag time (L)

$$L = \frac{l^{.8}(S+1)^{.7}}{1900(Y)^{.5}}$$

$$L = \frac{(18000)^{.8}(4.51)^{.7}}{(1900)(2.2)^{.5}}$$

$$L = 2.58 \text{ hr.} \leftarrow$$

$$T_c = \frac{L}{.6} = 4.3 \text{ hr}$$

* County Soil Survey - Sussex NJ (SCS)

** Table 2-2, SCS TR-55

BY KK	DATE 9-17-80	Lake Lenape	JOB NO. 80145
CKD Dng	DATE 3/3/81		SHEET NO. 2 OF

LANGAN ENGINEERING ASSOCIATES, INC.

2) From Nomograph (Small Dams pg 71)

T_c for $\left\{ \begin{matrix} L = 18000 \\ H = 400 \end{matrix} \right\}$ $T_c = 1.0$ hr.

$Lag = .6 T_c = 0.6$ hr. (too small)

③ Estimate T_c from velocity and watercourse lengths

length = 18000

avg slope = 1.5 %

∴ avg velocity* = 2 f/s

$$t_c = \frac{18000 \text{ ft}}{2 \text{ ft/sec}} = 2.5 \text{ hr.}$$

$Lag = .6(T_c) = 1.5$ hrs.

Use $L = 2.04$ hrs

* from Small Dams pg 70

BY VU	DATE 7-17-80	Lake Lenape	JOB NO. 80195
CKD Ry	DATE 3/3/81		SHEET NO. 3 OF

LANGAN ENGINEERING ASSOCIATES, INC.

SPILLWAY CAPACITY

Although the upstream portion of the spillway crest is rounded, the curvature does not extend to the upstream toe of the weir; therefore we shall consider the spillway to be a broadcrested weir with a length of 34 ft and a width of 1½ feet. The crest of the spillway which is made of concrete is at elevation 105.6.

The spillway is located roughly at the center of the dam and has no control gates. A 20" cast iron outlet pipe is located on the east portion of the dam near the spillway. Its operational condition is unknown; therefore for the purpose of analysis this structure will be assumed inoperable.

BY RW DATE 9-17-80 Lake Lenape JOB NO. 80145

CKD [illegible] DATE 3/3/81 SHEET NO. 4 OF

LANGAN ENGINEERING ASSOCIATES, INC.

BY RWG DATE 9/30/80 LAKE LENAPE JOB NO. 80145

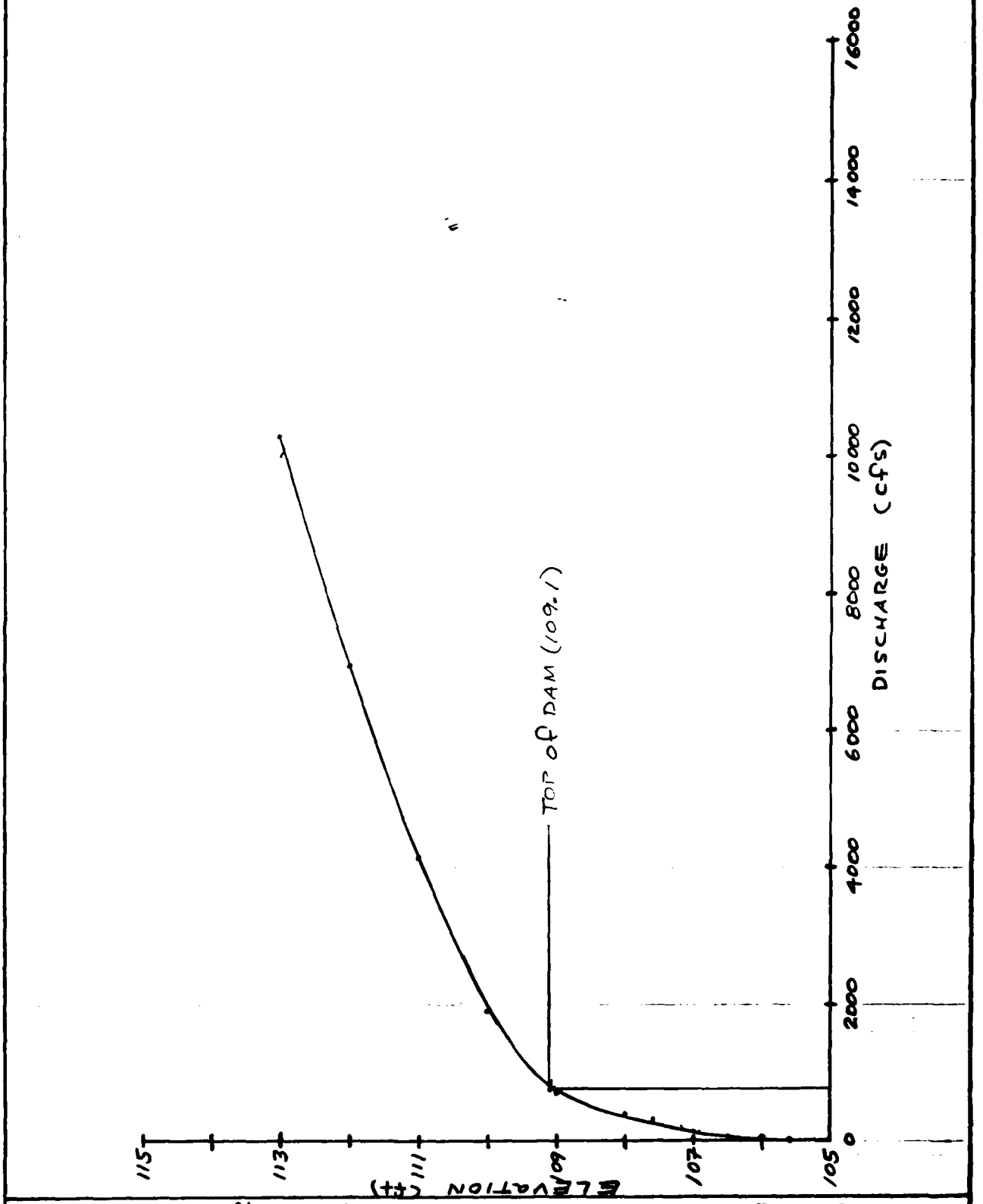
CKD [illegible] DATE 3/3/81 SPILLWAY Rating SHEET NO. 5 OF ___

ELEVATION (ft)	SPILLWAY L = 34' W = 1.5'			EMBANKMENT L = 395 W = 10			ΣQ
	HEAD (ft)	C	Q_S cfs	HEAD (ft)	C	Q_E (cfs)	$Q_S + Q_E$ (cfs)
105.6	0	—	0				0
106.0	0.4	2.64	23				23
106.5	0.9	2.72	79				79
107.0	1.4	2.92	165				165
107.5	1.9	3.03	270				270
108.0	2.4	3.23	408				408
109.0	3.4	3.32	707				707
109.1	3.5	3.32	739	0			739
110.0	4.4	3.32	1042	0.9	2.60	877	1919
111.0	5.4	3.32	1416	1.9	2.64	2731	4147
112.0	6.4	3.32	1827	2.9	2.64	5150	6977
113.0	7.4	3.32	2273	3.9	2.64	8031	10304

NOTE: WEIR FLOW CALCULATED using $Q = CLH^{3/2}$
C Values obtained from TABLE 5-3, HANDBOOK of HYDRAULICS

SPILLWAY CAPACITY SUMMARY

LANGAN ENGINEERING ASSOCIATES, INC.



BY RWG DATE 9/30/80 LAKE LENAPE JOB NO. 80195

CKD Dy DATE 3/17/81 SHEET NO. 6 OF

LANGAN ENGINEERING ASSOCIATES, INC.

Reservoir Storage Capacity — LAKE Lenape Dam

Assume a linear distribution for the area of the lake with elevation. Start at a Zero storage at the crest of the spillway.

Area of Lake = 44.08 ac (Determined by planimeter and 1971 USGS map)

Length of equivalent square = 1385.69 ft

Take average side slope: 3 V : 1 H

∴ for every foot of water above the crest of the spillway the length of the equivalent square increases by: 2 × 3 × 1 = 6 ft

Elevation (ft)	H (ft)	Length of Equiv. Square (ft)	Area of Lake (acres)
105.5	0	1385.69	44.08
106.0	0.4	1388.09	44.23
107.0	1.4	1394.09	44.62
108.0	2.4	1400.09	45.00
109.0	3.4	1406.09	45.39
109.1	3.5	1406.69	45.43
110	4.4	1412.09	45.77
111	5.4	1418.09	46.16
112	6.4	1424.09	46.56
113	7.4	1430.09	46.95
114	8.4	1436.09	47.34

Storage Capacity vs. elevation is calculated by HEC 1

BY RWG\VU DATE 9-17-80 Lake Lenape JOB NO. 80195

CKD RJ DATE 3/3/81 SHEET NO. 7 OF

LANGAN ENGINEERING ASSOCIATES, INC.

SUMMARY OF HYDROGRAPH AND FLOOD ROUTING

1) HYDROGRAPH & Routing CALCULATED USING HEC-1

2) PMF for LAKE LENAPE IS 13843. cfs (Routed to 13772 cfs)

3) Routing of PMF INDICATES THE DAM WILL OVERTOP BY 4.94 ft.

4) Routing of 1/2 PMF INDICATES the DAM WILL OVERTOP BY 2.51 ft.

Note: Calculated peak inflow by HEC-1 is slightly higher than the maximum discharge in the input spillway rating curve (13843 cfs vs 10304 cfs). However, any discharge slightly higher than that in the rating curve is very close to a value which can be linearly extrapolated from the curve which is what the computer program HEC-1 does. Therefore the results using the input rating curve as described on previous pages is considered to be valid.

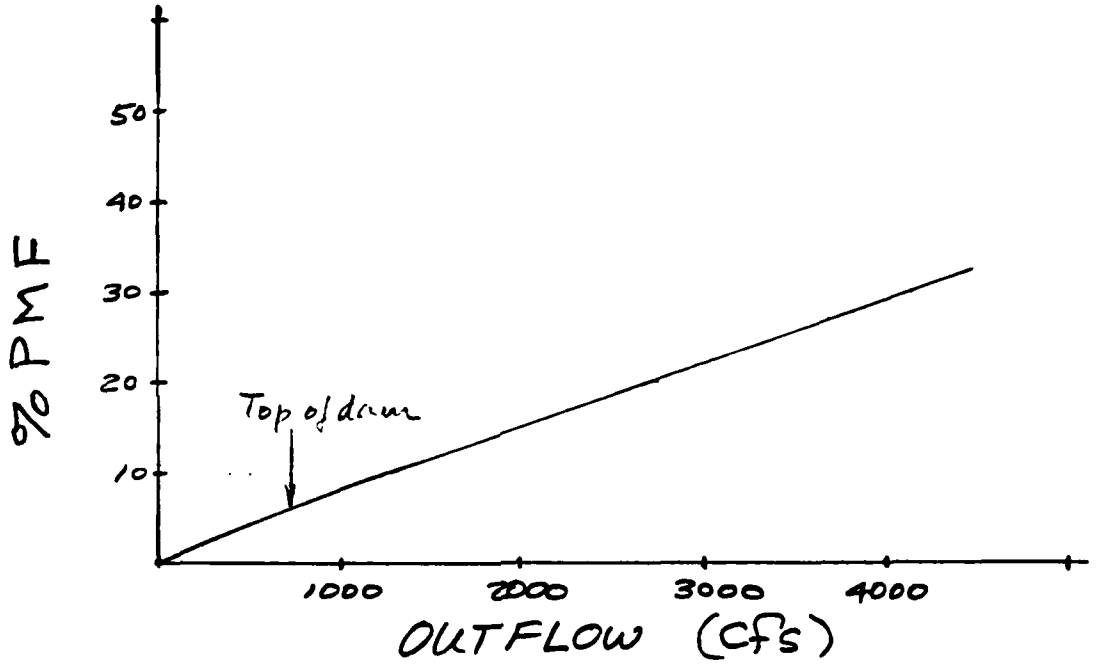
BY RWG	DATE 10/6/80	HEC 1 SUMMARY	JOB NO. 80145
CKD. RM	DATE 3/4/81	LAKE LENAPE	SHEET NO. 8 OF

LANGAN ENGINEERING ASSOCIATES, INC.

OVERTOPPING POTENTIAL

1) VARIOUS % of PMF HAVE BEEN ROUTED USING HEC-1

2) PLOT PEAK OUTFLOW VS % PMF



3) DAM OVERTOPS AT ELEVATION 109.1 WITH Q = 739 cfs. ∴ DAM CAN PASS APPROXIMATELY 6% OF THE PMF.

BY RWG DATE 10/6/80 LAKE LENAPE JOB NO. 80145

CKD. RJ DATE 3/4/81 SHEET NO. 9 OF

LANGAN ENGINEERING ASSOCIATES, INC.

DRAWDOWN ANALYSIS

1) Outlet Structure

One 20" diameter cast iron low level outlet pipe with shutoff valve. The operational status of this valve is questionable, but for this analysis it will be considered to be operational.

2) Outlet Capacity

a) elevation of centerline of outfall end of pipe = 82.8 (est)

b) Elevation of lake = crest of ~~dam~~ spillway = 105.6
Length of pipe = 60' ±

c) Pipe capacity based on

$Q = C_p H^{1/2}$ where $C_p = A_p \sqrt{\frac{2g}{1+K_m+K_p L}}$

using $n = .025$, $K_p = .0590$ (NEH Sec 5. ES-12)

$A_p = 2.18 f^2$, $K_m = 0.9$

$C_p = 7.5$, $Q = 7.5 H^{1/2}$

BY VU DATE 2-17-81 Lake Lenape JOB NO. 80145

CKD [illegible] DATE 3/4/81 drawdown SHEET NO. 10 OF

LANGAN ENGINEERING ASSOCIATES, INC.

$Q = 2.5\ H^{1/2}$

Elev (ft)	Head (ft)	Q (cfs)	Qavg (cfs)
105.6	22.8	35.8	
			35.1
104	21.2	34.5	
			33.7
102	19.2	32.8	
			31.9
100	17.2	31.1	
			30.2
98	15.2	29.2	
			28.2
96	13.2	27.2	
			26.2
94	11.2	25.1	
			23.9
92	9.2	22.7	
			21.4
90	7.2	20.1	
			18.6
88	5.2	17.1	
			15.3
86	3.2	13.4	
			10.8
84	1.2	8.2	
			4.1
82	0	0	

BY VH DATE 9-17-80 Lake Lenape JOB NO. 80145

CKD. SM DATE 3/19/81 drawdown SHEET NO. 11 OF

LANGAN ENGINEERING ASSOCIATES, INC.

STORage Capacity

a) use method of Equivalent squares to calculate STORage

b) SURFACE area at SPILLWAY CREST ELEV 105.6 IS 44.08 AC AND HAS AN EQUIVALENT SQUARE LENGTH of 1385.69 ft. ASSUME 3H:1V SIDE SLOPES

WATER ELEV ft.	LENGTH of Equivalent SQ - ft.	SURFACE AREA AC	ΔH ft	INCREMENTAL VOLUME AC-ft	VOLUME AC-ft
105.6	1385.69	44.08	0	—	939
104	1376.09	43.47	1.6	70	869
102	1364.09	42.72	2	86	783
100	1352.09	41.97	2	85	698
98	1340.09	41.23	2	83	615
96	1328.09	40.49	2	82	533
94	1316.09	39.76	2	80	453
92	1304.09	39.04	2	79	374
90	1292.09	38.33	2	77	297
88	1280.09	37.62	2	76	221
86	1268.09	36.92	2	76	145
84	1256.09	36.22	2	73	72
82	1244.09	35.53	2	72	0

BY RWG DATE 2-26-81 LAKE LENAPE JOB NO. 80145

CKD. [illegible] DATE 3/6/81 STORAGE VS ELEV SHEET NO. 12 OF

LANGAN ENGINEERING ASSOCIATES, INC.

Assume inflow to be 2 cfs/sq. mi

$Q_{in} = 2 \times 5.16 \doteq 10$ cfs

Elev. (ft)	$Q_{out\ avg}$ (cfs)	Q_{net}* (cfs)	Δ Storage (Ac-ft)	Δt (hrs)	Σ Δt (hrs)	
105.6						
	35	25	70	33.9	33.9	
104						
	33	23	68	45.2	79.1	
102						
	32	22	65	46.8	125.9	— 5.2 days
100						
	30	20	63	50.2	176.1	
98						
	28	18	62	55.1	231.2	
96						
	26	16	60	60.5	291.7	— 12.2 days
94						
	24	14	59	68.3	360.0	
92						
	22	12	57	77.6	437.6	
90						
	18	8	56	115.0	552.6	
88						
	15	5	56	183.9	736.5	
86						
	11	1	53	883.3	1619.8	
84						
	4	—	52			
82						

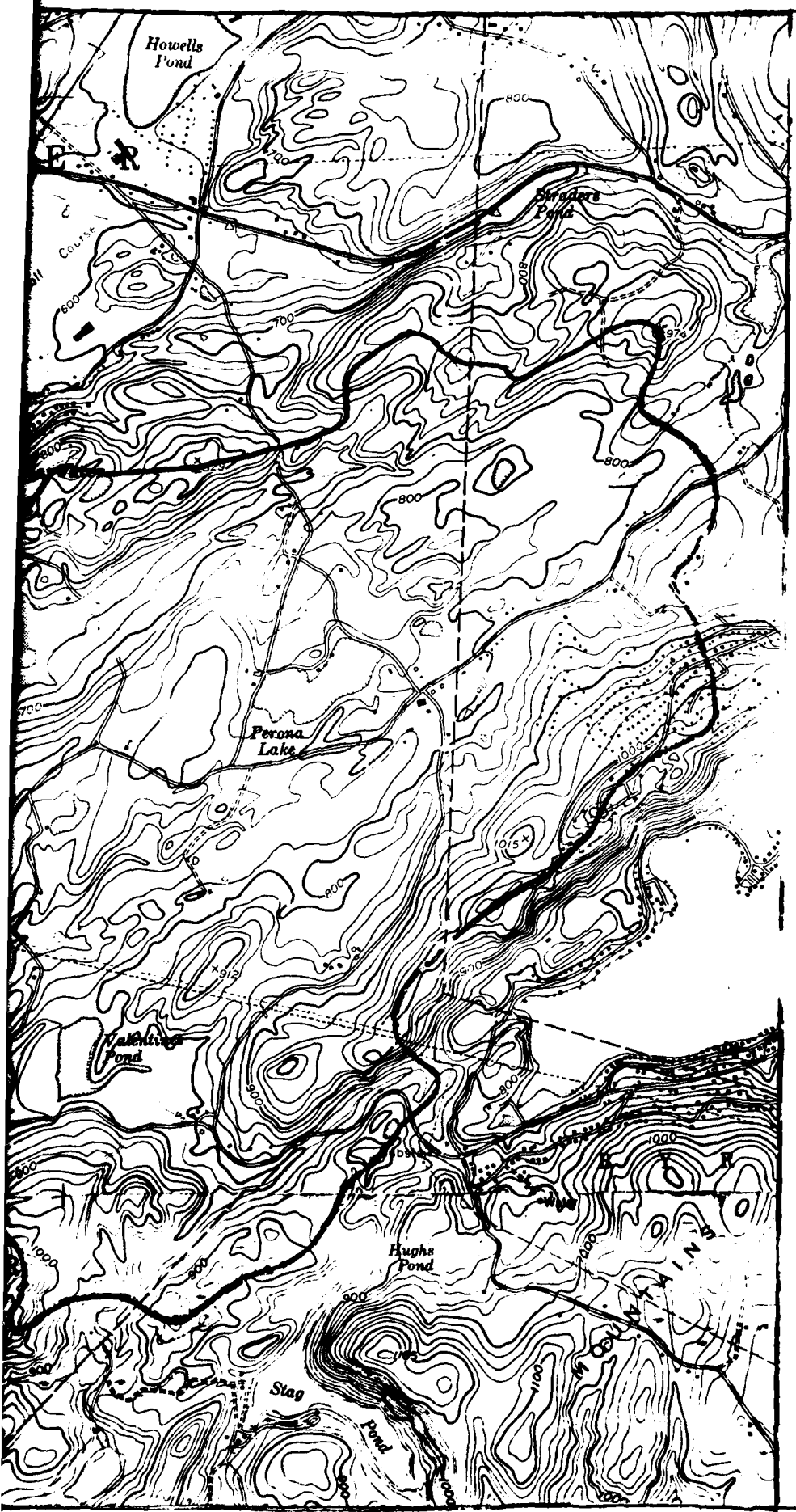
* $Q_{net} = Q_{out\ avg} - Q_{in} = Q_{out\ avg} - 10$

Lake can be lowered 5½ ft in about 5 days and 11½ ft in about 12 days.

BY: [illegible] DATE 3/14/81 Lake Lenape JOB NO. 80145

CKD RWG DATE 3/5/81 SHEET NO. 13 OF


Howells Pond
ANDOVER
Golf Course
Lake Tiffi
BM
LEHIGH
New Wawayanda Lake
Perona Lake
Lake Lenape
Rocker Pond
Hughs Pond
Stag Pond
BORO
ANDOVER



DRAINAGE BASIN
LENAPE DAM

MAP SOURCE : USGS
SCALE : 1" = 2000'

NEWTON EAST

J 80145

HEC-1 OUTPUT

LAKE LENAPE DAM

```
LENOUT3    12:41 MAR 04,'81

1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
 **********************************
     1                A1              LAKE LENAPE DAM (00019)
     2                A2              INFLOW HYDROGRAPHY AND ROUTING
     3                A3              N.J. DAM INSPECTION
     4                B    290        0       10        0        0        0        0        0        0        0
     5                B1     3
     6                K      0        1                                          1
     7                K1 COMPUTE HYDROGRAPH
     8                M      1        2     5.16                        .80
     9                P      0     22.2      112      123      132      142
    10                T                                                  1      .15
    11                W2          2.04
    12                X     -2                1
    13                K      1        2                                          1
    14                K1 ROUTING COMPUTATIONS
    15                Y                                 1
    16                Y1     1                                                  -1
    17                Y4 105.6      106    106.5      107    107.5      108      109    109.1      110      111
    18                Y4   112      113
    19                Y5     0       23       79      165      270      408      707      739     1919      414
    20                Y5  6977    10304
    21                $A 44.08    44.23    44.62    45.00    45.39    45.43    45.77    46.16    46.56    46.95
    22                $E 105.6      106      107      108      109    109.1      110      111      112      113
    23                $$ 105.6
    24                $D 109.1
    25                K     99
1                            PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                 RUNOFF HYDROGRAPH AT          1
                                 ROUTE HYDROGRAPH TO           2
                                 END OF NETWORK


1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
 **********************************

 RUN  DATE# 81/03/04.
      TIME# 12.39.56.


                                 LAKE LENAPE DAM (00019)
                                 INFLOW HYDROGRAPHY AND ROUTING
                                 N.J. DAM INSPECTION

                                          JOB SPECIFICATION
                      NQ       NHR      NMIN      IDAY       IHR      IMIN     METRC      IPLT      IPRT     NSTAN
                     290         0        10         0         0         0         0         0         0         0
                                          JOPER       NWT     LROPT     IRACE
                                             3         0         0         0
```

SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	5.16	0.00	5.16	.80	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.20	112.00	123.00	132.00	142.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.15	0.00	0.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= 2.04

RECESSION DATA

STRTQ= -2.00 QRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 63 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= 2.04 VOL= 1.00

28.	82.	155.	243.	353.	497.	662.	827.	970.	1072.
1136.	1166.	1171.	1162.	1107.	1045.	977.	900.	808.	699.
600.	518.	454.	399.	351.	311.	277.	244.	216.	188.
165.	146.	128.	113.	100.	87.	77.	67.	59.	52.
46.	41.	36.	32.	28.	24.	21.	19.	17.	15.
13.	12.	11.	10.	8.	7.	6.	5.	4.	3.
2.	2.	1.							

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.00	0.00	.00	10.	1.02	.20	146	.02	0.00	.02	15.
1.01	.20	2	.00	0.00	.00	10.	1.02	.30	147	.02	0.00	.02	15.
1.01	.30	3	.00	0.00	.00	10.	1.02	.40	148	.02	0.00	.02	14.
1.01	.40	4	.00	0.00	.00	10.	1.02	.50	149	.02	0.00	.02	14.
1.01	.50	5	.00	0.00	.00	10.	1.02	1.00	150	.02	0.00	.02	13.
1.01	1.00	6	.00	0.00	.00	10.	1.02	1.10	151	.02	0.00	.02	13.
1.01	1.10	7	.00	0.00	.00	10.	1.02	1.20	152	.02	0.00	.02	12.
1.01	1.20	8	.00	0.00	.00	10.	1.02	1.30	153	.02	0.00	.02	12.
1.01	1.30	9	.00	0.00	.00	10.	1.02	1.40	154	.02	0.00	.02	12.
1.01	1.40	10	.00	0.00	.00	10.	1.02	1.50	155	.02	0.00	.02	11.
1.01	1.50	11	.00	0.00	.00	10.	1.02	2.00	156	.02	0.00	.02	11.
1.01	2.00	12	.00	0.00	.00	10.	1.02	2.10	157	.02	0.00	.02	11.
1.01	2.10	13	.00	0.00	.00	10.	1.02	2.20	158	.02	0.00	.02	11.
1.01	2.20	14	.00	0.00	.00	10.	1.02	2.30	159	.02	0.00	.02	11.
1.01	2.30	15	.00	0.00	.00	10.	1.02	2.40	160	.02	0.00	.02	11.
1.01	2.40	16	.00	0.00	.00	10.	1.02	2.50	161	.02	0.00	.02	11.
1.01	2.50	17	.00	0.00	.00	10.	1.02	3.00	162	.02	0.00	.02	10.
1.01	3.00	18	.00	0.00	.00	10.	1.02	3.10	163	.02	0.00	.02	10.
1.01	3.10	19	.00	0.00	.00	10.	1.02	3.20	164	.02	0.00	.02	10.
1.01	3.20	20	.00	0.00	.00	10.	1.02	3.30	165	.02	0.00	.02	10.
1.01	3.30	21	.00	0.00	.00	10.	1.02	3.40	166	.02	0.00	.02	10.
1.01	3.40	22	.00	0.00	.00	10.	1.02	3.50	167	.02	0.00	.02	10.
1.01	3.50	23	.00	0.00	.00	10.	1.02	4.00	168	.02	0.00	.02	10.
1.01	4.00	24	.00	0.00	.00	10.	1.02	4.10	169	.02	0.00	.02	10.
1.01	4.10	25	.00	0.00	.00	10.	1.02	4.20	170	.02	0.00	.02	10.
1.01	4.20	26	.00	0.00	.00	10.	1.02	4.30	171	.02	0.00	.02	10.
1.01	4.30	27	.00	0.00	.00	10.	1.02	4.40	172	.02	0.00	.02	10.
1.01	4.40	28	.00	0.00	.00	10.	1.02	4.50	173	.02	0.00	.02	10.

1.01	5.00	30	.00	0.00	.00	10.	1.02	5.10	175	.02	0.00	.02	10.
1.01	5.10	31	.00	0.00	.00	10.	1.02	5.20	176	.02	0.00	.02	10.
1.01	5.20	32	.00	0.00	.00	10.	1.02	5.30	177	.02	0.00	.02	10.
1.01	5.30	33	.00	0.00	.00	10.	1.02	5.40	178	.02	0.00	.02	10.
1.01	5.40	34	.00	0.00	.00	10.	1.02	5.50	179	.02	0.00	.02	10.
1.01	5.50	35	.00	0.00	.00	10.	1.02	6.00	180	.02	0.00	.02	10.
1.01	6.00	36	.00	0.00	.00	10.	1.02	6.10	181	.05	.03	.03	11.
1.01	6.10	37	.00	0.00	.00	10.	1.02	6.20	182	.05	.03	.03	14.
1.01	6.20	38	.00	0.00	.00	10.	1.02	6.30	183	.05	.03	.03	18.
1.01	6.30	39	.00	0.00	.00	10.	1.02	6.40	184	.05	.03	.03	25.
1.01	6.40	40	.00	0.00	.00	10.	1.02	6.50	185	.05	.03	.03	35.
1.01	6.50	41	.00	0.00	.00	10.	1.02	7.00	186	.05	.03	.03	50.
1.01	7.00	42	.00	0.00	.00	10.	1.02	7.10	187	.05	.03	.03	69.
1.01	7.10	43	.00	0.00	.00	10.	1.02	7.20	188	.05	.03	.03	94.
1.01	7.20	44	.00	0.00	.00	10.	1.02	7.30	189	.05	.03	.03	122.
1.01	7.30	45	.00	0.00	.00	10.	1.02	7.40	190	.05	.03	.03	153.
1.01	7.40	46	.00	0.00	.00	10.	1.02	7.50	191	.05	.03	.03	187.
1.01	7.50	47	.00	0.00	.00	10.	1.02	8.00	192	.05	.03	.03	221.
1.01	8.00	48	.00	0.00	.00	10.	1.02	8.10	193	.05	.03	.03	255.
1.01	8.10	49	.00	0.00	.00	10.	1.02	8.20	194	.05	.03	.03	289.
1.01	8.20	50	.00	0.00	.00	10.	1.02	8.30	195	.05	.03	.03	321.
1.01	8.30	51	.00	0.00	.00	10.	1.02	8.40	196	.05	.03	.03	352.
1.01	8.40	52	.00	0.00	.00	10.	1.02	8.50	197	.05	.03	.03	381.
1.01	8.50	53	.00	0.00	.00	10.	1.02	9.00	198	.05	.03	.03	407.
1.01	9.00	54	.00	0.00	.00	10.	1.02	9.10	199	.05	.03	.03	431.
1.01	9.10	55	.00	0.00	.00	10.	1.02	9.20	200	.05	.03	.03	451.
1.01	9.20	56	.00	0.00	.00	10.	1.02	9.30	201	.05	.03	.03	469.
1.01	9.30	57	.00	0.00	.00	10.	1.02	9.40	202	.05	.03	.03	484.
1.01	9.40	58	.00	0.00	.00	10.	1.02	9.50	203	.05	.03	.03	497.
1.01	9.50	59	.00	0.00	.00	10.	1.02	10.00	204	.05	.03	.03	509.
1.01	10.00	60	.00	0.00	.00	10.	1.02	10.10	205	.05	.03	.03	519.
1.01	10.10	61	.00	0.00	.00	10.	1.02	10.20	206	.05	.03	.03	528.
1.01	10.20	62	.00	0.00	.00	10.	1.02	10.30	207	.05	.03	.03	536.
1.01	10.30	63	.00	0.00	.00	10.	1.02	10.40	208	.05	.03	.03	543.
1.01	10.40	64	.00	0.00	.00	10.	1.02	10.50	209	.05	.03	.03	550.
1.01	10.50	65	.00	0.00	.00	10.	1.02	11.00	210	.05	.03	.03	555.
1.01	11.00	66	.00	0.00	.00	10.	1.02	11.10	211	.05	.03	.03	560.
1.01	11.10	67	.00	0.00	.00	10.	1.02	11.20	212	.05	.03	.03	564.
1.01	11.20	68	.00	0.00	.00	10.	1.02	11.30	213	.05	.03	.03	568.
1.01	11.30	69	.00	0.00	.00	10.	1.02	11.40	214	.05	.03	.03	571.
1.01	11.40	70	.00	0.00	.00	10.	1.02	11.50	215	.05	.03	.03	574.
1.01	11.50	71	.00	0.00	.00	10.	1.02	12.00	216	.05	.03	.03	577.
1.01	12.00	72	.00	0.00	.00	10.	1.02	12.10	217	.33	.31	.03	587.
1.01	12.10	73	.03	0.00	.03	10.	1.02	12.20	218	.33	.31	.03	611.
1.01	12.20	74	.03	0.00	.03	10.	1.02	12.30	219	.33	.31	.03	656.
1.01	12.30	75	.03	0.00	.03	10.	1.02	12.40	220	.33	.31	.03	725.
1.01	12.40	76	.03	0.00	.03	10.	1.02	12.50	221	.33	.31	.03	824.
1.01	12.50	77	.03	0.00	.03	10.	1.02	13.00	222	.33	.31	.03	963.
1.01	13.00	78	.03	0.00	.03	10.	1.02	13.10	223	.40	.37	.03	1149.
1.01	13.10	79	.03	0.00	.03	10.	1.02	13.20	224	.40	.37	.03	1385.
1.01	13.20	80	.03	0.00	.03	10.	1.02	13.30	225	.40	.37	.03	1665.
1.01	13.30	81	.03	0.00	.03	10.	1.02	13.40	226	.40	.37	.03	1979.
1.01	13.40	82	.03	0.00	.03	10.	1.02	13.50	227	.40	.37	.03	2318.
1.01	13.50	83	.03	0.00	.03	10.	1.02	14.00	228	.40	.37	.03	2674.
1.01	14.00	84	.03	0.00	.03	10.	1.02	14.10	229	.50	.47	.03	3046.
1.01	14.10	85	.04	0.00	.04	10.	1.02	14.20	230	.50	.47	.03	3432.
1.01	14.20	86	.04	0.00	.04	10.	1.02	14.30	231	.50	.47	.03	3819.
1.01	14.30	87	.04	0.00	.04	10.	1.02	14.40	232	.50	.47	.03	4204.
1.01	14.40	88	.04	0.00	.04	10.	1.02	14.50	233	.50	.47	.03	4585.
1.01	14.50	89	.04	0.00	.04	10.	1.02	15.00	234	.50	.47	.03	4962.
1.01	15.00	90	.04	0.00	.04	10.	1.02	15.10	235	.45	.43	.03	5320.
1.01	15.10	91	.03	0.00	.03	10.	1.02	15.20	236	.76	.73	.03	5686.
1.01	15.20	92	.06	0.00	.06	10.	1.02	15.30	237	1.36	1.34	.03	6058.
1.01	15.30	93	.10	0.00	.10	10.	1.02	15.40	238	3.40	3.38	.03	6519.
1.01	15.40	94	.26	.19	.07	15.	1.02	15.50	239	.98	.96	.03	7075.

1.01	16.00	96	.05	.02	.03	44.	1.02	16.10	241	.46	.44	.03	8388.
1.01	16.10	97	.04	.01	.03	65.	1.02	16.20	242	.46	.44	.03	9164.
1.01	16.20	98	.04	.01	.03	92.	1.02	16.30	243	.46	.44	.03	10045.
1.01	16.30	99	.04	.01	.03	128.	1.02	16.40	244	.46	.44	.03	10978.
1.01	16.40	100	.04	.01	.03	171.	1.02	16.50	245	.46	.44	.03	11876.
1.01	16.50	101	.04	.01	.03	216.	1.02	17.00	246	.46	.44	.03	12645.
1.01	17.00	102	.04	.01	.03	260.	1.02	17.10	247	.36	.34	.03	13214.
1.01	17.10	103	.03	.00	.03	295.	1.02	17.20	248	.36	.34	.03	13588.
1.01	17.20	104	.03	.00	.03	323.	1.02	17.30	249	.36	.34	.03	13789.
1.01	17.30	105	.03	.00	.03	343.	1.02	17.40	250	.36	.34	.03	13843.
1.01	17.40	106	.03	.00	.03	356.	1.02	17.50	251	.36	.34	.03	13776.
1.01	17.50	107	.03	.00	.03	364.	1.02	18.00	252	.36	.34	.03	13534.
1.01	18.00	108	.03	.00	.03	361.	1.02	18.10	253	.03	.00	.03	13205.
1.01	18.10	109	.00	0.00	.00	354.	1.02	18.20	254	.03	.00	.03	12796.
1.01	18.20	110	.00	0.00	.00	342.	1.02	18.30	255	.03	.00	.03	12297.
1.01	18.30	111	.00	0.00	.00	327.	1.02	18.40	256	.03	.00	.03	11693.
1.01	18.40	112	.00	0.00	.00	306.	1.02	18.50	257	.03	.00	.03	10997.
1.01	18.50	113	.00	0.00	.00	280.	1.02	19.00	258	.03	.00	.03	10283.
1.01	19.00	114	.00	0.00	.00	254.	1.02	19.10	259	.03	.00	.03	9580.
1.01	19.10	115	.00	0.00	.00	229.	1.02	19.20	260	.03	.00	.03	8895.
1.01	19.20	116	.00	0.00	.00	207.	1.02	19.30	261	.03	.00	.03	8211.
1.01	19.30	117	.00	0.00	.00	187.	1.02	19.40	262	.03	.00	.03	7535.
1.01	19.40	118	.00	0.00	.00	168.	1.02	19.50	263	.03	.00	.03	6877.
1.01	19.50	119	.00	0.00	.00	152.	1.02	20.00	264	.03	.00	.03	6240.
1.01	20.00	120	.00	0.00	.00	137.	1.02	20.10	265	.03	.00	.03	5618.
1.01	20.10	121	.00	0.00	.00	122.	1.02	20.20	266	.03	.00	.03	5029.
1.01	20.20	122	.00	0.00	.00	110.	1.02	20.30	267	.03	.00	.03	4475.
1.01	20.30	123	.00	0.00	.00	98.	1.02	20.40	268	.03	.00	.03	3967.
1.01	20.40	124	.00	0.00	.00	87.	1.02	20.50	269	.03	.00	.03	3507.
1.01	20.50	125	.00	0.00	.00	78.	1.02	21.00	270	.03	.00	.03	3084.
1.01	21.00	126	.00	0.00	.00	70.	1.02	21.10	271	.03	.00	.03	2710.
1.01	21.10	127	.00	0.00	.00	63.	1.02	21.20	272	.03	.00	.03	2382.
1.01	21.20	128	.00	0.00	.00	57.	1.02	21.30	273	.03	.00	.03	2097.
1.01	21.30	129	.00	0.00	.00	51.	1.02	21.40	274	.03	.00	.03	1851.
1.01	21.40	130	.00	0.00	.00	46.	1.02	21.50	275	.03	.00	.03	1633.
1.01	21.50	131	.00	0.00	.00	42.	1.02	22.00	276	.03	.00	.03	1445.
1.01	22.00	132	.00	0.00	.00	38.	1.02	22.10	277	.03	.00	.03	1279.
1.01	22.10	133	.00	0.00	.00	35.	1.02	22.20	278	.03	.00	.03	1131.
1.01	22.20	134	.00	0.00	.00	32.	1.02	22.30	279	.03	.00	.03	1000.
1.01	22.30	135	.00	0.00	.00	29.	1.02	22.40	280	.03	.00	.03	884.
1.01	22.40	136	.00	0.00	.00	27.	1.02	22.50	281	.03	.00	.03	782.
1.01	22.50	137	.00	0.00	.00	25.	1.02	23.00	282	.03	.00	.03	693.
1.01	23.00	138	.00	0.00	.00	23.	1.02	23.10	283	.03	.00	.03	614.
1.01	23.10	139	.00	0.00	.00	22.	1.02	23.20	284	.03	.00	.03	545.
1.01	23.20	140	.00	0.00	.00	20.	1.02	23.30	285	.03	.00	.03	483.
1.01	23.30	141	.00	0.00	.00	19.	1.02	23.40	286	.03	.00	.03	429.
1.01	23.40	142	.00	0.00	.00	18.	1.02	23.50	287	.03	.00	.03	382.
1.01	23.50	143	.00	0.00	.00	17.	1.03	0.00	288	.03	.00	.03	341.
1.02	0.00	144	.00	0.00	.00	16.	1.03	.10	289	0.00	0.00	0.00	306.
1.02	.10	145	.02	0.00	.02	16.	1.03	.20	290	0.00	0.00	0.00	274.
									SUM	25.22	20.44	4.78	409311.
										(641.)	(519.)	(121.)	(11590.40)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13843.	9182.	2785.	1411.	409201.
CMS	392.	260.	79.	40.	11587.
INCHES		16.55	20.08	20.49	20.49
MM		420.47	510.15	520.49	520.49
AC-FT		4553.	5524.	5636.	5636.
THOUS CU M		5616.	6814.	6952.	6952.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING COMPUTATIONS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	-1

STAGE	105.60	106.00	106.50	107.00	107.50	108.00	109.00	109.10	110.00	111.00
	112.00	113.00								
FLOW	0.00	23.00	79.00	165.00	270.00	408.00	707.00	739.00	1919.00	414.00
	6977.00	10304.00								
SURFACE AREA=	44.	44.	45.	45.	45.	45.	46.	46.	47.	47.
CAPACITY=	0.	18.	62.	107.	152.	157.	198.	244.	290.	337.
ELEVATION=	106.	106.	107.	108.	109.	109.	110.	111.	112.	113.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
105.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
109.1	0.0	0.0	0.

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	.10	1	.17	10.	0.	0.	105.6
1.01	.20	2	.33	10.	0.	0.	105.6
1.01	.30	3	.50	10.	1.	0.	105.6
1.01	.40	4	.67	10.	1.	1.	105.6
1.01	.50	5	.83	10.	1.	1.	105.6
1.01	1.00	6	1.00	10.	1.	1.	105.6
1.01	1.10	7	1.17	10.	1.	1.	105.6
1.01	1.20	8	1.33	10.	1.	1.	105.6
1.01	1.30	9	1.50	10.	2.	1.	105.6
1.01	1.40	10	1.67	10.	2.	1.	105.6
1.01	1.50	11	1.83	10.	2.	1.	105.6
1.01	2.00	12	2.00	10.	2.	2.	105.6
1.01	2.10	13	2.17	10.	2.	2.	105.6
1.01	2.20	14	2.33	10.	2.	2.	105.6
1.01	2.30	15	2.50	10.	2.	2.	105.6
1.01	2.40	16	2.67	10.	3.	2.	105.6
1.01	2.50	17	2.83	10.	3.	2.	105.6
1.01	3.00	18	3.00	10.	3.	2.	105.6
1.01	3.10	19	3.17	10.	3.	2.	105.7
1.01	3.20	20	3.33	10.	3.	2.	105.7
1.01	3.30	21	3.50	10.	3.	2.	105.7
1.01	3.40	22	3.67	10.	3.	3.	105.7
1.01	3.50	23	3.83	10.	3.	3.	105.7
1.01	4.00	24	4.00	10.	4.	3.	105.7

1.01	4.30	27	4.50	10.	4.	3.	105.7
1.01	4.40	28	4.67	10.	4.	3.	105.7
1.01	4.50	29	4.83	10.	4.	3.	105.7
1.01	5.00	30	5.00	10.	4.	3.	105.7
1.01	5.10	31	5.17	10.	4.	3.	105.7
1.01	5.20	32	5.33	10.	5.	3.	105.7
1.01	5.30	33	5.50	10.	5.	4.	105.7
1.01	5.40	34	5.67	10.	5.	4.	105.7
1.01	5.50	35	5.83	10.	5.	4.	105.7
1.01	6.00	36	6.00	10.	5.	4.	105.7
1.01	6.10	37	6.17	10.	5.	4.	105.7
1.01	6.20	38	6.33	10.	5.	4.	105.7
1.01	6.30	39	6.50	10.	5.	4.	105.7
1.01	6.40	40	6.67	10.	5.	4.	105.7
1.01	6.50	41	6.83	10.	5.	4.	105.7
1.01	7.00	42	7.00	10.	5.	4.	105.7
1.01	7.10	43	7.17	10.	6.	4.	105.7
1.01	7.20	44	7.33	10.	6.	4.	105.7
1.01	7.30	45	7.50	10.	6.	4.	105.7
1.01	7.40	46	7.67	10.	6.	4.	105.7
1.01	7.50	47	7.83	10.	6.	5.	105.7
1.01	8.00	48	8.00	10.	6.	5.	105.7
1.01	8.10	49	8.17	10.	6.	5.	105.7
1.01	8.20	50	8.33	10.	6.	5.	105.7
1.01	8.30	51	8.50	10.	6.	5.	105.7
1.01	8.40	52	8.67	10.	6.	5.	105.7
1.01	8.50	53	8.83	10.	6.	5.	105.7
1.01	9.00	54	9.00	10.	6.	5.	105.7
1.01	9.10	55	9.17	10.	6.	5.	105.7
1.01	9.20	56	9.33	10.	7.	5.	105.7
1.01	9.30	57	9.50	10.	7.	5.	105.7
1.01	9.40	58	9.67	10.	7.	5.	105.7
1.01	9.50	59	9.83	10.	7.	5.	105.7
1.01	10.00	60	10.00	10.	7.	5.	105.7
1.01	10.10	61	10.17	10.	7.	5.	105.7
1.01	10.20	62	10.33	10.	7.	5.	105.7
1.01	10.30	63	10.50	10.	7.	5.	105.7
1.01	10.40	64	10.67	10.	7.	5.	105.7
1.01	10.50	65	10.83	10.	7.	5.	105.7
1.01	11.00	66	11.00	10.	7.	5.	105.7
1.01	11.10	67	11.17	10.	7.	6.	105.7
1.01	11.20	68	11.33	10.	7.	6.	105.7
1.01	11.30	69	11.50	10.	7.	6.	105.7
1.01	11.40	70	11.67	10.	7.	6.	105.7
1.01	11.50	71	11.83	10.	7.	6.	105.7
1.01	12.00	72	12.00	10.	7.	6.	105.7
1.01	12.10	73	12.17	10.	8.	6.	105.7
1.01	12.20	74	12.33	10.	8.	6.	105.7
1.01	12.30	75	12.50	10.	8.	6.	105.7
1.01	12.40	76	12.67	10.	8.	6.	105.7
1.01	12.50	77	12.83	10.	8.	6.	105.7
1.01	13.00	78	13.00	10.	8.	6.	105.7
1.01	13.10	79	13.17	10.	8.	6.	105.7
1.01	13.20	80	13.33	10.	8.	6.	105.7
1.01	13.30	81	13.50	10.	8.	6.	105.7
1.01	13.40	82	13.67	10.	8.	6.	105.7
1.01	13.50	83	13.83	10.	8.	6.	105.7
1.01	14.00	84	14.00	10.	8.	6.	105.7
1.01	14.10	85	14.17	10.	8.	6.	105.7
1.01	14.20	86	14.33	10.	8.	6.	105.7
1.01	14.30	87	14.50	10.	8.	6.	105.7
1.01	14.40	88	14.67	10.	8.	6.	105.7
1.01	14.50	89	14.83	10.	8.	6.	105.7

1.01	15.30	93	15.50	10.	8.	6.	105.7
1.01	15.40	94	15.67	15.	8.	6.	105.7
1.01	15.50	95	15.83	27.	9.	7.	105.8
1.01	16.00	96	16.00	44.	9.	7.	105.8
1.01	16.10	97	16.17	65.	10.	8.	105.8
1.01	16.20	98	16.33	92.	11.	9.	105.8
1.01	16.30	99	16.50	128.	13.	10.	105.8
1.01	16.40	100	16.67	171.	15.	12.	105.9
1.01	16.50	101	16.83	216.	19.	14.	105.9
1.01	17.00	102	17.00	260.	22.	17.	106.0
1.01	17.10	103	17.17	295.	31.	21.	106.1
1.01	17.20	104	17.33	323.	40.	24.	106.2
1.01	17.30	105	17.50	343.	50.	28.	106.2
1.01	17.40	106	17.67	356.	60.	32.	106.3
1.01	17.50	107	17.83	364.	71.	37.	106.4
1.01	18.00	108	18.00	361.	81.	40.	106.5
1.01	18.10	109	18.17	354.	96.	44.	106.6
1.01	18.20	110	18.33	342.	109.	48.	106.7
1.01	18.30	111	18.50	327.	121.	51.	106.7
1.01	18.40	112	18.67	306.	131.	53.	106.8
1.01	18.50	113	18.83	280.	139.	55.	106.8
1.01	19.00	114	19.00	254.	146.	57.	106.9
1.01	19.10	115	19.17	229.	151.	58.	106.9
1.01	19.20	116	19.33	207.	154.	59.	106.9
1.01	19.30	117	19.50	187.	156.	60.	106.9
1.01	19.40	118	19.67	168.	157.	60.	107.0
1.01	19.50	119	19.83	152.	158.	60.	107.0
1.01	20.00	120	20.00	137.	157.	60.	107.0
1.01	20.10	121	20.17	122.	155.	60.	106.9
1.01	20.20	122	20.33	110.	153.	59.	106.9
1.01	20.30	123	20.50	98.	151.	58.	106.9
1.01	20.40	124	20.67	87.	148.	58.	106.9
1.01	20.50	125	20.83	78.	144.	57.	106.9
1.01	21.00	126	21.00	70.	141.	56.	106.9
1.01	21.10	127	21.17	63.	137.	55.	106.8
1.01	21.20	128	21.33	57.	133.	54.	106.8
1.01	21.30	129	21.50	51.	129.	53.	106.8
1.01	21.40	130	21.67	46.	125.	52.	106.8
1.01	21.50	131	21.83	42.	121.	51.	106.7
1.01	22.00	132	22.00	38.	116.	49.	106.7
1.01	22.10	133	22.17	35.	112.	48.	106.7
1.01	22.20	134	22.33	32.	108.	47.	106.7
1.01	22.30	135	22.50	29.	104.	46.	106.6
1.01	22.40	136	22.67	27.	100.	45.	106.6
1.01	22.50	137	22.83	25.	96.	44.	106.6
1.01	23.00	138	23.00	23.	93.	43.	106.6
1.01	23.10	139	23.17	22.	89.	42.	106.6
1.01	23.20	140	23.33	20.	85.	41.	106.5
1.01	23.30	141	23.50	19.	82.	41.	106.5
1.01	23.40	142	23.67	18.	79.	40.	106.5
1.01	23.50	143	23.83	17.	77.	39.	106.5
1.02	0.00	144	24.00	16.	75.	38.	106.5
1.02	.10	145	24.17	16.	73.	37.	106.4
1.02	.20	146	24.33	15.	71.	37.	106.4
1.02	.30	147	24.50	15.	69.	36.	106.4
1.02	.40	148	24.67	14.	67.	35.	106.4
1.02	.50	149	24.83	14.	65.	34.	106.4
1.02	1.00	150	25.00	13.	63.	34.	106.4
1.02	1.10	151	25.17	13.	62.	33.	106.3
1.02	1.20	152	25.33	12.	60.	32.	106.3
1.02	1.30	153	25.50	12.	58.	32.	106.3
1.02	1.40	154	25.67	12.	57.	31.	106.3
1.02	1.50	155	25.83	11.	55.	30.	106.3

1.02	2.30	159	26.50	11.	49.	28.	106.2
1.02	2.40	160	26.67	11.	48.	28.	106.2
1.02	2.50	161	26.83	11.	47.	27.	106.2
1.02	3.00	162	27.00	10.	46.	27.	106.2
1.02	3.10	163	27.17	10.	44.	26.	106.2
1.02	3.20	164	27.33	10.	43.	26.	106.2
1.02	3.30	165	27.50	10.	42.	25.	106.2
1.02	3.40	166	27.67	10.	41.	25.	106.2
1.02	3.50	167	27.83	10.	40.	24.	106.2
1.02	4.00	168	28.00	10.	39.	24.	106.1
1.02	4.10	169	28.17	10.	38.	24.	106.1
1.02	4.20	170	28.33	10.	37.	23.	106.1
1.02	4.30	171	28.50	10.	36.	23.	106.1
1.02	4.40	172	28.67	10.	35.	22.	106.1
1.02	4.50	173	28.83	10.	34.	22.	106.1
1.02	5.00	174	29.00	10.	34.	22.	106.1
1.02	5.10	175	29.17	10.	33.	22.	106.1
1.02	5.20	176	29.33	10.	32.	21.	106.1
1.02	5.30	177	29.50	10.	31.	21.	106.1
1.02	5.40	178	29.67	10.	31.	21.	106.1
1.02	5.50	179	29.83	10.	30.	20.	106.1
1.02	6.00	180	30.00	10.	29.	20.	106.1
1.02	6.10	181	30.17	11.	29.	20.	106.0
1.02	6.20	182	30.33	14.	28.	20.	106.0
1.02	6.30	183	30.50	18.	28.	19.	106.0
1.02	6.40	184	30.67	25.	27.	19.	106.0
1.02	6.50	185	30.83	35.	27.	19.	106.0
1.02	7.00	186	31.00	50.	28.	20.	106.0
1.02	7.10	187	31.17	69.	29.	20.	106.1
1.02	7.20	188	31.33	94.	31.	21.	106.1
1.02	7.30	189	31.50	122.	33.	22.	106.1
1.02	7.40	190	31.67	153.	37.	23.	106.1
1.02	7.50	191	31.83	187.	42.	25.	106.2
1.02	8.00	192	32.00	221.	47.	27.	106.2
1.02	8.10	193	32.17	255.	54.	30.	106.3
1.02	8.20	194	32.33	289.	61.	33.	106.3
1.02	8.30	195	32.50	321.	69.	36.	106.4
1.02	8.40	196	32.67	352.	79.	40.	106.5
1.02	8.50	197	32.83	381.	93.	44.	106.6
1.02	9.00	198	33.00	407.	109.	48.	106.7
1.02	9.10	199	33.17	431.	125.	52.	106.8
1.02	9.20	200	33.33	451.	141.	56.	106.9
1.02	9.30	201	33.50	469.	158.	60.	107.0
1.02	9.40	202	33.67	484.	176.	64.	107.1
1.02	9.50	203	33.83	497.	196.	69.	107.1
1.02	10.00	204	34.00	509.	215.	73.	107.2
1.02	10.10	205	34.17	519.	234.	77.	107.3
1.02	10.20	206	34.33	528.	252.	81.	107.4
1.02	10.30	207	34.50	536.	270.	84.	107.5
1.02	10.40	208	34.67	543.	291.	88.	107.6
1.02	10.50	209	34.83	550.	312.	91.	107.7
1.02	11.00	210	35.00	555.	332.	94.	107.7
1.02	11.10	211	35.17	560.	350.	97.	107.8
1.02	11.20	212	35.33	564.	367.	100.	107.9
1.02	11.30	213	35.50	568.	383.	103.	107.9
1.02	11.40	214	35.67	571.	398.	105.	108.0
1.02	11.50	215	35.83	574.	413.	108.	108.0
1.02	12.00	216	36.00	577.	427.	110.	108.1
1.02	12.10	217	36.17	587.	441.	112.	108.1
1.02	12.20	218	36.33	611.	454.	114.	108.2
1.02	12.30	219	36.50	656.	470.	116.	108.2
1.02	12.40	220	36.67	725.	489.	119.	108.3
1.02	12.50	221	36.83	824.	514.	123.	108.4
1.02	13.00	222	37.00	963.	547.	128.	108.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1.02	13.30	225	37.50	1665.	728.	155.	109.1
1.02	13.40	226	37.67	1979.	1060.	168.	109.3
1.02	13.50	227	37.83	2318.	1420.	180.	109.6
1.02	14.00	228	38.00	2674.	1775.	193.	109.9
1.02	14.10	229	38.17	3046.	1539.	209.	110.3
1.02	14.20	230	38.33	3432.	551.	239.	110.9
1.02	14.30	231	38.50	3819.	3220.	263.	111.4
1.02	14.40	232	38.67	4204.	4001.	269.	111.5
1.02	14.50	233	38.83	4585.	4389.	272.	111.6
1.02	15.00	234	39.00	4962.	4769.	274.	111.7
1.02	15.10	235	39.17	5328.	5140.	277.	111.7
1.02	15.20	236	39.33	5686.	5502.	280.	111.8
1.02	15.30	237	39.50	6058.	5867.	282.	111.8
1.02	15.40	238	39.67	6519.	6282.	285.	111.9
1.02	15.50	239	39.83	7075.	6790.	289.	112.0
1.02	16.00	240	40.00	7700.	7246.	294.	112.1
1.02	16.10	241	40.17	8388.	7772.	301.	112.2
1.02	16.20	242	40.33	9164.	8433.	310.	112.4
1.02	16.30	243	40.50	10045.	9203.	321.	112.7
1.02	16.40	244	40.67	10978.	10062.	333.	112.9
1.02	16.50	245	40.83	11876.	10957.	346.	113.2
1.02	17.00	246	41.00	12645.	11810.	358.	113.5
1.02	17.10	247	41.17	13214.	12542.	368.	113.7
1.02	17.20	248	41.33	13588.	13103.	376.	113.8
1.02	17.30	249	41.50	13789.	13485.	382.	114.0
1.02	17.40	250	41.67	13843.	13701.	385.	114.0
1.02	17.50	251	41.83	13776.	13772.	386.	114.0
1.02	18.00	252	42.00	13534.	13696.	385.	114.0
1.02	18.10	253	42.17	13205.	13483.	382.	114.0
1.02	18.20	254	42.33	12796.	13168.	377.	113.9
1.02	18.30	255	42.50	12297.	12762.	372.	113.7
1.02	18.40	256	42.67	11693.	12261.	364.	113.6
1.02	18.50	257	42.83	10997.	11661.	356.	113.4
1.02	19.00	258	43.00	10283.	10992.	346.	113.2
1.02	19.10	259	43.17	9580.	10297.	337.	113.0
1.02	19.20	260	43.33	8895.	9602.	327.	112.8
1.02	19.30	261	43.50	8211.	8913.	317.	112.6
1.02	19.40	262	43.67	7535.	8229.	308.	112.4
1.02	19.50	263	43.83	6877.	7555.	298.	112.2
1.02	20.00	264	44.00	6240.	6859.	289.	112.0
1.02	20.10	265	44.17	5618.	5943.	283.	111.8
1.02	20.20	266	44.33	5029.	5332.	278.	111.7
1.02	20.30	267	44.50	4475.	4760.	274.	111.7
1.02	20.40	268	44.67	3967.	4228.	271.	111.6
1.02	20.50	269	44.83	3507.	3743.	267.	111.5
1.02	21.00	270	45.00	3084.	3301.	264.	111.4
1.02	21.10	271	45.17	2710.	2902.	261.	111.4
1.02	21.20	272	45.33	2382.	2551.	259.	111.3
1.02	21.30	273	45.50	2097.	2245.	257.	111.3
1.02	21.40	274	45.67	1851.	1979.	255.	111.2
1.02	21.50	275	45.83	1633.	1746.	253.	111.2
1.02	22.00	276	46.00	1445.	1542.	252.	111.2
1.02	22.10	277	46.17	1279.	1364.	250.	111.1
1.02	22.20	278	46.33	1131.	1207.	249.	111.1
1.02	22.30	279	46.50	1000.	1067.	248.	111.1
1.02	22.40	280	46.67	884.	944.	247.	111.1
1.02	22.50	281	46.83	782.	835.	247.	111.1
1.02	23.00	282	47.00	693.	739.	246.	111.0
1.02	23.10	283	47.17	614.	654.	245.	111.0
1.02	23.20	284	47.33	545.	580.	245.	111.0
1.02	23.30	285	47.50	483.	515.	244.	111.0
1.02	23.40	286	47.67	429.	457.	244.	111.0
1.02	23.50	287	47.83	382.	417.	244.	111.0
1.03	0.00	288	48.00	341.	449.	243.	111.0
1.03	.10	289	48.17	306.	522.	240.	110.9

PEAK OUTFLOW IS 13772. AT TIME 41.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13772.	9179.	2685.	1352.	392067.
CMS	390.	260.	76.	38.	11102.
INCHES		16.55	19.36	19.63	19.63
MM		420.32	491.72	498.69	498.69
AC-FT		4552.	5325.	5400.	5400.
THOUS CU M		5614.	6568.	6661.	6661.

********** ********** ********** ********** **********

1

RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	13843.	9182.	2785.	1411.	5.16
		(392.00)(	260.02)(	78.87)(	39.96)(	13.36)
ROUTED TO	2	13772.	9179.	2685.	1352.	5.16
		(389.98)(	259.93)(	76.02)(	38.28)(	13.36)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	105.60	105.60	109.10
STORAGE	0.	0.	157.
OUTFLOW	0.	0.	739.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.00	114.04	4.94	386.	13772.	10.83	41.83	0.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

```
LENSOUT    13:05 MAR 04,'81

1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
 **********************************
1                              PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                     RUNOFF HYDROGRAPH AT          1
                                     ROUTE HYDROGRAPH TO           2
                                     END OF NETWORK


1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
 **********************************

 RUN  DATE= 81/03/04.
      TIME= 13.03.51.


                                LAKE LENAPE DAM (00019)
                                INFLOW HYDROGRAPHY AND ROUTING
                                N.J. DAM INSPECTION

                                          JOB SPECIFICATION
                    NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
                   290        0       10        0        0        0        0        0        4        0
                                                JOPER      NWT   LROPT    TRACE
                                                    5        0        0        0


                                          MULTI-PLAN ANALYSES TO BE PERFORMED
                                                NPLAN= 1 NRTIO= 5 LRTIO= 1
                              RTIOS=     .10     .20     .30     .40     .50

**********          **********          **********          **********          **********

                                          SUB-AREA RUNOFF COMPUTATION

                    COMPUTE HYDROGRAPH

                                    ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                        1       0       0       0       0       0       1       0       0

                                                HYDROGRAPH DATA
                                IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                                    1       2    5.16    0.00    5.16     .80   0.000       0       0       0

                                                PRECIP DATA
                                        SPFE     PMS      R6     R12     R24     R48     R72     R96
                                        0.00   22.20  112.00  123.00  132.00  142.00    0.00    0.00

                                                LOSS DATA
                                LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
                                    0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .15    0.00    0.00
```

TC= 0.00 LAG= 2.04

RECESSION DATA

STRTQ= -2.00 QRCSN= 0.00 RTIOR= 1.00

0 MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.22	20.44	4.78	409311.
										(641.)	(519.)	(121.)	(11590.40)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING COMPUTATIONS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	-1

STAGE	105.60	106.00	106.50	107.00	107.50	108.00	109.00	109.10	110.00	111.00
	112.00	113.00								
FLOW	0.00	23.00	79.00	165.00	270.00	408.00	707.00	739.00	1919.00	414.00
	6977.00	10304.00								
SURFACE AREA=	44.	44.	45.	45.	45.	45.	46.	46.	47.	47.
LAPACITY=	0.	18.	62.	107.	152.	157.	198.	244.	290.	337.
ELEVATION=	106.	106.	107.	108.	109.	109.	110.	111.	112.	113.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
105.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
109.1	0.0	0.0	0.

PEAK OUTFLOW IS 1275. AT TIME 42.33 HOURS

PEAK OUTFLOW IS 2762. AT TIME 41.67 HOURS

PEAK OUTFLOW IS 4143. AT TIME 41.67 HOURS

PEAK OUTFLOW IS 5524. AT TIME 41.83 HOURS

PEAK OUTFLOW IS 6904. AT TIME 41.83 HOURS

********** ********** ********** ********** **********

1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50
HYDROGRAPH AT	1	5.16	1	1384.	2769.	4153.	5537.	6922.
		(13.36)	(	39.20)(	78.40)(	117.60)(	156.80)(	196.00)(
ROUTED TO	2	5.16	1	1275.	2762.	4143.	5524.	6904.
		(13.36)	(	36.12)(	78.22)(	117.32)(	156.42)(	195.51)(

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	105.60	105.60	109.10
STORAGE	0.	0.	157.
OUTFLOW	0.	0.	739.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	109.51	.41	175.	1275.	2.67	42.33	0.00
.20	111.36	2.26	260.	2762.	7.17	41.67	0.00
.30	111.57	2.47	270.	4143.	8.33	41.67	0.00
.40	111.78	2.68	280.	5524.	9.33	41.83	0.00
.50	111.99	2.89	289.	6904.	10.00	41.83	0.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

APPENDIX 4
REFERENCES

APPENDIX 4

REFERENCES
LAKE LENAPE DAM

1. N.J. DEP Dam Application #80 File.

2. Details of Proposed Dam and Plan Profile & Cross Sections - Lake Lenape, Andover Township, Sussex County, N.J. for the Lenape Corp., Inc. Prepared by Snook & Hardin Engineers, Newton, N.J., May 1926.

3. Monthly Progress Reports by Snook & Hardin, June thru Dec 1926.

4. Dam inspections by John N. Brooks, Hydraulic Eng., Trenton, N.J., 1 & 15 June, 28 Sept, 28 Oct 1926.

5. Dam inspection by H. T. Critchlow, Chief, Div. of Waters, Trenton, N.J., 3 Sept 1926.

6. Report on Dam Inspection - Lake Lenape Dam, Dam Application #80 by James C. Riley, 11 Oct 1961.

7. Brater, Ernest F. and Kings, Horace W. Handbook of Hydraulics 5th Edition, McGraw-Hill Book Company 1963.

8. Sauls, G.A., Additional Hydrology and Hydraulics Guidance, 12 Sept 1978.

9. United States Army Corps of Engineers, Recommended Guidelines for Safety Inspection of Dams, Washington, D. C.

10. United States Army Corps of Engineers, Flood Hydrograph Package (HEC-1), Davis, Calif., Sept 1978.

11. United Stated Dept. of Agriculture, Soil Conservation Service, Soil Survey of Sussex County and Morris County, August 1975.

12. United States Dept. of Agriculture, Soil Conservation Service, Somerset, N.J. Urban Hydrology for Small Watersheds, Technical Release No 55, Jan 1975.

13. United States Dept. of Agriculture, Soil Conservation Service, A Method for Estimating Volume and Rate of Runoff in Small Watersheds SCS-TP149, Revised April 1973.

14. United States Dept. of Commerce Weather Bureau, April 1956, Hydrometeorological Report #33, Washington, D.C.

15. United States Dept. of Interior, Bureau of Reclamation Design of Small Dams, Second Edition 1973, Revised print 1977.


DATE
ILME